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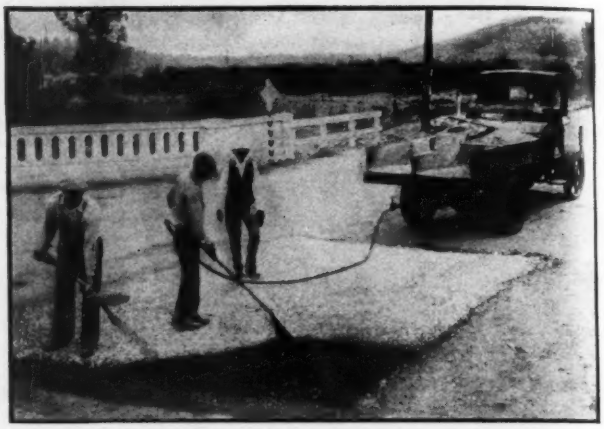

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Five-Mile Seawall Built on Precast Piles

Stepped slab of reinforced concrete, carried on cutoff wall of concrete sheetpiling and two rows of piles, protects New Orleans against Lake Pontchartrain floods—Constructed from land side behind wall of steel sheeting

By H. A. Christie

Project Manager, Raymond Concrete Pile Co., New York City

THE LONG-EXISTING possibility that New Orleans might be flooded by hurricane winds piling up the waters of shallow Lake Pontchartrain against the inadequately protected north side of the city has been removed by the building of a 5¼-mile seawall along the lakefront. The wall, rising 10 ft. above mean lake level, is a stepped reinforced-concrete slab carried on a toewall of concrete sheetpiles and two longitudinal rows of square precast bearing piles, with occasional batter piles providing resistance against displacement. It extends for 27,819 ft. from New Canal on the west to the Inner Harbor Navigation Canal on the east, as shown in Fig. 2, and crosses several waterways. One of the waterways, St. John's Bayou, is navigable, and locks are being installed for flood protection. Construction of the wall was carried on from the land side, behind the protection of a wall of steel sheeting driven outside the toe of the main wall.

The seawall consists of an inclined concrete deck carried on precast concrete piling, as shown in Fig. 3. Under the lake-side edge of the deck is a cutoff wall of 9x24-in. tongue-and-grooved precast concrete sheetpiles. Two longitudinal rows of 12x12-in. precast concrete piles, 8 ft. c. to c., were driven under the center and back side of the deck. The deck is 12 in. in minimum thickness, the upper face being stepped. Except for a distance of 4,000 ft., the wall follows the irregular shoreline. It was built in 40-ft. chord units, none of the sections themselves being curved. At both ends of each slab section is a curb built flush with the tops of the steps. The curbs are normally 8 in. wide but vary in width from top to bottom to act as fillers in the angular space between chord sections where the wall is curved. Expansion joints of 1-in. premolded mastic were placed between the 40-ft. wall units. To stiffen

Fig. 1—Stepped-slab seawall follows irregular shoreline of Lake Pontchartrain at New Orleans' back door.

the wall against possible displacement, three concrete batter piles were driven in each section along the back row of vertical piles. In one stretch over unusually soft ground, where there was a possibility of a slide toward the lake, additional batter piles were driven and the wall was tied back to anchors on solid ground by heavy rods. The deck slab and all piles are heavily reinforced and tied together.

In the entire project there are 9,235 12x12-in. piles 22 to 46 ft. long, and 13,803 9x24-in. concrete sheetpiles 20 to 38 ft. long, which required 37,237 cu.yd. of concrete and 6,026 tons of reinforcing steel. The deck slab contains 31,700 cu.yd. of concrete and 2,747 tons of steel. In building the deck, 615,000 sq.ft. of forms was required for the under side and 494,000 sq.ft. for the steps.

Construction plan

Careful consideration was given by the contractor to the advantages of building the wall from the land side, using standard land equipment and transporting materials by rail, or from the lake side, using floating equipment and water delivery of materials. Previous unfavorable experience with storms and rough water on Lake Pontchartrain and the fact that some 4,000 ft. of the wall is on land, necessitating either land work or considerable dredging to use floating equipment for its construction, led to the decision to do the entire job from the land side.

In general, the construction program was as follows: A central pile-casting yard, in which aggregates for the deck concrete were batched, was established at the lakefront. A steel sheetpile protection wall was driven about 4 ft. outside the main-wall toeline. Behind this line of sheeting a dry fill was placed by draglines to an elevation slightly above lake level. Standard piledrivers were skidded on this fill for driving all concrete piling. Concrete materials and piles were transported over a narrow-gage track from the casting yard to the site of work. A traveling concrete plant, operating on a wide-gage track, was used in pouring the deck concrete.

Pile-casting yard

The central pile-casting yard was located on the lakefront at the end of an abandoned standard-gage railroad running from the downtown section of the city. This road was put back into service for the delivery of materials needed for the work. Casting platforms were laid out over an area 58 ft. wide and 830 ft. long. On half of this area were built 200 forms for the square piles, and on the other half 350 sheetpile forms were built, each form being carried independently on a set of stakes. Along one side of the platform space was a run for concrete buggies; on the other side was a pile-storage space 50 ft. wide. The pile-yard layout is shown in Fig. 5.

Piles were cast parallel to the length

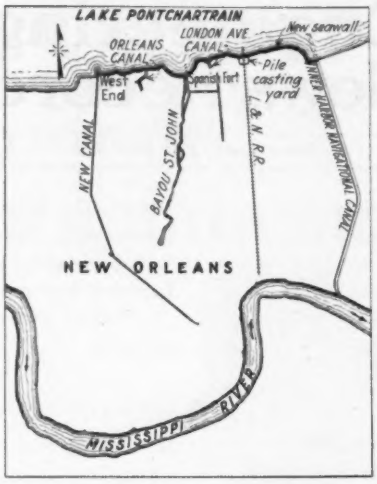


Fig. 2—Map showing location of 5¼-mile seawall at New Orleans.

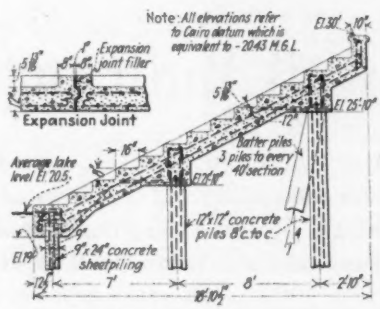


Fig. 3—Lake Pontchartrain seawall consists of reinforced stepped slab carried on precast sheet and square concrete piles.

of the yard. A steam-operated gantry crane of 145-ft. span, having a transverse traveling carriage, stored and loaded all the piles and handled all reinforcing steel. The gantry carried a lifting beam with an adjustable multiple-point pick-up for handling the piles. Reinforcing was the only construction material received by barges. This was purchased bent and bundled ready for use. At the water end of the yard a trestle extended out into the lake to enable the gantry crane to pick up the steel from the delivery barges and place

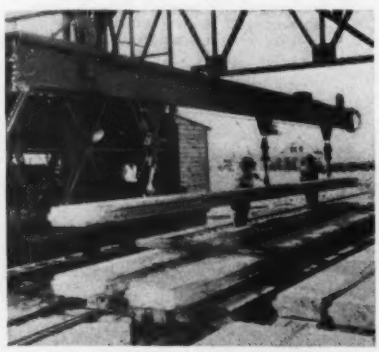


Fig. 4—Gantry-crane lifting beam handling precast sheetpiles at pile-casting yard. Beam has adjustable pick-up points to accommodate various lengths of piles.

it in storage in a yard near the waterfront. When the pile reinforcing cages had been fabricated, the gantry, using a special multiple lifting beam, would pick up eight to ten cages and place them in the forms. The lifters on the beam were so arranged that when the ten cages were dropped they were correctly spaced in the forms. Reinforcing steel for the deck slab was also handled by the cranes, being loaded onto narrow-gage cars. Finished piles were loaded onto similar cars for transportation to the job.

A central concrete plant was located at the mid-point of the casting platform. Sand and gravel, received in standard-gage cars, were unloaded by a stiff-leg derrick set up on a bridge spanning the material tracks. Elevating the derrick provided more storage space for material and permitted the operator a clear view of his work. The storage hoppers on the mixer were charged by this derrick. Cement in bags was carried from a storage shed to the mixing platform by a belt conveyor. Aggregates were batched by weighing. The same plant was used for dry-batching aggregates, including cement, for the deck slabs, the materials being hauled out in batch boxes set on flat cars.

Concrete for the piles was transported from the plant to the forms in buggies. An electric vibrator tamped the concrete in the forms. It was mounted on a 2x4-in. timber that was inserted into the concrete. Piles were cured in the forms for seven days by a burlap covering kept wet by a water-spray system, then transferred to the stock pile for a minimum of 21 days before being removed for driving. In the storage yard the piles were kept wet an additional seven days, making a total of fourteen days of wet-curing.

Waterfront plant

The waterfront work was organized in two similar units. Each unit contained the following plant and equipment: one full-revolving piledriver for driving concrete sheetpiles; one full-revolving piledriver with batter lead attachment for driving both vertical and batter square concrete piles; one special steel gantry for handling wall forms; two sets special steel forms for the upper side of the slab; one traveling concrete-mixing plant with tower and chutes; one 16-in. electrically driven centrifugal pump for unwatering the cofferdam; two small gas-driven centrifugal pumps; one light skid rig for driving temporary piles; one floating rig for driving steel sheeting; and one dragline for excavation and fill work. One diesel towboat and a derrick boat were in general service.

Piledriving

The new wall was, in general, located about 40 ft. in front of an old wooden bulkhead that formed the original shoreline. This extended the full length ex-

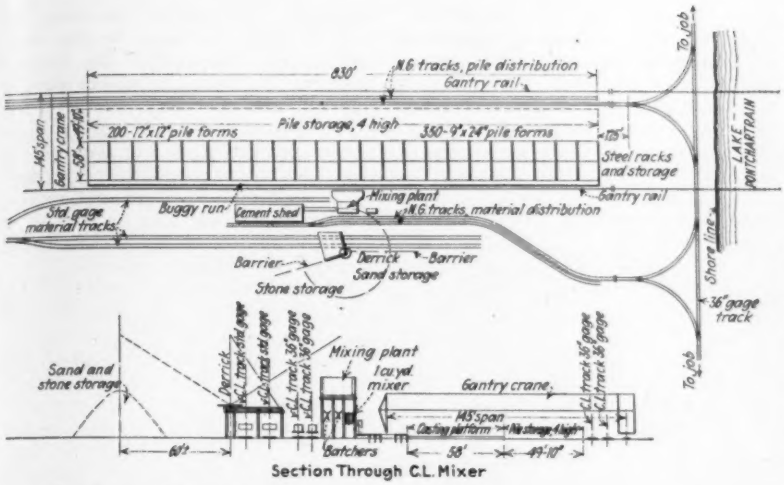


Fig. 5—Layout of pile-casting yard, located at lakefront.

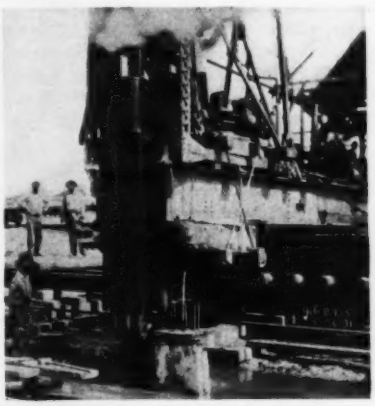


Fig. 6—Special follower used in driving concrete sheetpiles.

cept across three waterways, Orleans Canal, London Ave. Canal and St. John's Bayou, and a stretch of 3,000 ft. across an amusement park beach at Spanish Fort.

The first step in piledriving was to drive, with floating equipment, a row of wood piles, 10 ft. c. to c., 4 ft. outside the toeline of the proposed wall. Temporary wales were placed on these piles to serve as guides for a line of steel sheeting driven as a protection or cofferdam wall. Between the steel sheeting and the old bulkhead was placed a dry fill to El. 21 or 22, normal lake level being El. 20.5. The fill material was dug from the land side by a dragline. This fill served to carry the skid drivers to follow later in driving the concrete piling. Every effort was made to keep the fill as low as possible, but still serving as a foundation for the drivers. At the same time that the dragline was placing the fill it piled up an embankment along the old bulkhead line to carry the narrow-gage railroad line to be used in distribution of piles and concrete materials. In some soft places it was necessary to carry this track on pile trestles.

In one soft ground section 40-ft. girders on temporary wood piling were necessary to carry the piledrivers. The 40-ft. length of girders corresponded to the panel length of wall, permitting the temporary supports to be curved with the wall. In sections where the new wall was entirely on land the necessary excavation was dug by dragline. Otherwise the construction operations were the same as for the waterfront sections.

At the west end of the project the ground was extremely soft, and it was impossible to throw up a berm with a dragline because the ground would not support the machine, neither would it consolidate when placed in the water so as to form a foundation for operating the piledrivers. A fairly good grade of material was available from the lake bottom, from 300 to 500 ft. offshore, and a long-boom clamshell dredge was therefore used to throw up a berm along the shoreline. This berm was built high enough and wide enough to carry the piledrivers and the narrow-gage railroad tracks, and the operations in this section were carried on just as though the wall were being built in the land section, no cofferdam sheeting being required.

Close behind the placing of the fill for the piledrivers followed the driving rig for the concrete sheetpiles for the toewall. As these piles carried bond rods extending out of the top, a special follower (Fig. 6) was required. The piles were driven until the tops reached El. 19.75. It was necessary to cut off very few piles to maintain the top at this elevation. Following close to the sheetpile driver was the rig for driving square piles. The leads of this driver were pivoted to permit driving of the batter piles.

All piles were delivered to the drivers

Fig. 7—General view of wall-building operations. Hand-excavating along toewall is shown in left foreground. Gantry carrying chute for final placing of deck concrete is shown next. Behind this gantry is another gantry for handling steel-form assembly used for steps. At right can be seen trestles carrying narrow-gage material tracks and concrete-plant tracks over a stretch of soft ground, with mixing plant in right background.

on 30-ft. cars hauled by 8-ton gas dinkies over the 36-in. gage track. In general, this track was built on and remained on the fill provided by the dragline. However, after a wall section along a stretch of winding shoreline had been completed, the track was straightened out to eliminate these curves and thus save time in transportation. Four dinkies and 42 cars handled all the piles, wall-reinforcing and concrete materials.

Deck construction

The deck slab was poured from a traveling concrete plant operating on wide-gage tracks temporarily laid alongside the narrow-gage railroad. As the building of the deck progressed, these rails were picked up and moved ahead. The traveling plant contained a mixer, tower and hoist, counterweighted chutes and a gas hoist for handling the boxes of batched aggregates hauled from the pile yard.

Some hand excavation was required along the sheetpile toewall to expose the top of the piles and permit placing of the bottom-slab forms. These forms, built of wood panel, rested on the ground at the lower end and were carried at the center and top by timber runners clamped to the square piles. No attempt was made to salvage that portion of the wood forms adjacent to the toewall. Steel forms, assembled in a unit for one 40-ft. wall section, were used for the steps of the top side of the deck.

The deck was poured in alternate 40-ft. sections. A wood gantry traveling on rails back of and in front of the wall carried a hopper and a chute with several gate openings in the bottom. The concrete was fed into the hopper on the gantry from the counterweighted chute on the mixing plant. While the concrete plant remained stationary during a pour, this gantry was moved back and forth, filling one step at a time, starting at the bottom. Electric vibrators, the same as used in the pile yard, tamped the deck concrete.

A steel-frame gantry, 40 ft. long, operating on the same tracks as the chute gantry, handled the steel-form sections from one wall unit to another. When necessary, a freshly poured slab section could be protected from rain by a canvas drawn over the form gantry.

Before starting the construction of a deck section it was necessary to remove a varying amount of water collected behind the steel sheeting. Usually two small gas-driven pumps could handle this water. Where these pumps were inadequate a 16-in. electric-drive centrifugal pump was used. This pump was mounted on a counterbalanced carriage, one leg of which rode on the bottom step of a completed wall section; the other leg, carrying a counterweight box, rode on the top step. Water from adjoining sections under construction was drained to this pump.

The seawall, built by the board of levee commissioners of the Orleans Levee District, replaces a temporary wood sheetpile bulkhead built about six years ago as the start of a combined shore-protection and lakefront fill project. The Orleans Dredging Co., contractors on this early work, placed 40,000,000 cu.yd. of fill behind the timber bulkhead by means of a hydraulic dredge at the rate of 800,000 cu.yd. per month.

A. L. Shushan is president of the board of levee commissioners; John Klorer is chief engineer; W. B. Davey, principal assistant engineer, was resident engineer on the entire project. A contract for the construction of the new wall was given to the Orleans Dredging Co., New Orleans, Jan. 15, 1930. Due to delay in connection with the bond issue for this work, actual construction of permanent work on the seawall was delayed until Sept. 30, 1930, although temporary construction facilities had been installed previous to this time. During this delay period the Orleans Dredging Co. signed an agency form of contract with the Raymond Concrete Pile Co., New York, covering the manufacture and driving of the piles and the placing of the slab, the Orleans company reserving for itself all general excavation, temporary fill and permanent fill that was ultimately placed under and behind the completed wall.

Placing of the concrete deck was completed Sept. 30, 1931, and the fill behind the wall was in place ten days thereafter, all the work being finished well within the contract time of 500 working days. Captain Nelson was in charge of operations for the Orleans Dredging Co. G. B. McGraw was general superintendent for the Raymond Concrete Pile Co., with the author as project manager in charge.

Unusual Girder Contour Marks New Concrete Bridge

Continuous girders proportioned to bending moments in new Buffalo River crossing at Houston, Tex.

By H. D. Hilborn
Assistant Engineer of Bridge Design, Houston, Tex.

THE NEW McKee St. bridge over the Buffalo River in Houston, Tex., represents a somewhat unusual solution of a problem complicated by some restrictions. The river crosses the street at an angle of about 77 deg. The War Department requirements, which had to be met because the stream is navigable for small craft, placed horizontal clearance at right angles to the channel at 100 ft. and vertical clearance above mean low water at 42 ft. First cost, maintenance and architectural appearance each exerted an influence on the choice of structure. The final decision was in favor of a continuous-girder, reinforced-concrete bridge with a channel span of 120 ft. c. to c. of piers and an 85-ft. approach span on each end placed on cellular-type abutments with wing walls extending back 40 ft. from the center of girder bearings. To provide for the skew, piers and abutments were laid out with the downstream footings offset 10 ft. As the floor beams were spaced 10 ft. c. to c., all except the two end floor beams (over the abutment seats) could thus be framed perpendicular to the girders. The restricted vertical clearance precluded serious consideration of deck-girder construction, which would have involved property damage along each

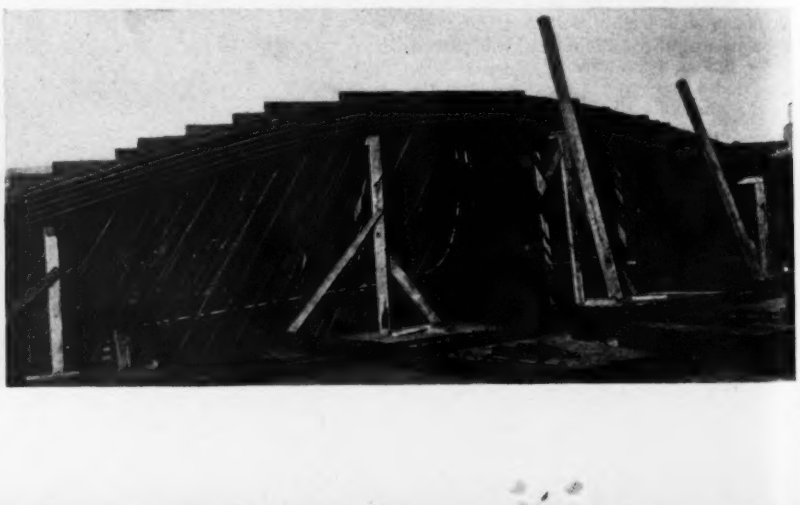


Fig. 1—Heavy reinforcing in girders over piers was supported on adjustable removable steel hangers carried on wood frames.

Fig. 2—Continuous concrete bridge over Buffalo River in Houston, Tex., in which girder contour follows the calculated bending-moment curve.

approach, as well as undesirable grades. Through construction, with girders proportioned to the bending moments, resulted in the unusual girder contour shown in Fig. 2. The depth from the top of the finished roadway to the clearance line on the 120-ft. span is 4 ft. 3 in.

In designing the bridge dead loads plus H20 live loading and impact were used. Four traffic lanes are accommodated by the 38-ft. roadway. In the 120-ft. span the girder soffit was given a parabolic rise of 3 in. in the half-span. The contour of the girder top is a reverse curve formed by the intersection of two simple parabolas at a point of tangency 15 ft. out from the center of support. At midspan there is a 20-ft. straight section tangent to the lower parabolic curve. The 60-ft. length of each of the 85-ft. spans adjacent to the piers duplicates one-half of the channel span. The remaining 25 ft. is a parabolic curve, having a rise of 5 ft., with its inner end tangent to the straight section.

In designing the girders the influence lines were drawn for reactions at abutments and at piers, based on the properties of girder section at 5-ft. intervals. Moment curves were then drawn for maximum moments in end spans, over supports and in the center span, as well as for dead load only. Moments and shears were figured for floor-beam points. The points of inflection under dead load only are about 35 ft. out from the center lines of the piers.

The possibility of overstressing the floor beams, which are 44 in. deep at the center and 42 in. at the ends, through excessive concentrations due to draglines or other extremely heavy loads, was provided for by three lines of 10x24-in. stringers, 10 ft. on centers, which serve to distribute such loads. This arrangement of the floor system divided the roadway slab into square panels, permitting of an economical arrangement of two-way steel.

Girders over the piers, extending from the top of the roadway slab to the top of the pier caps, provide lateral stiffening members for the pier bents, which were designed to be as flexible as possible. The height from the top of the pedestal to the girder seat is 39½ ft. The width of the pier at the bottom of the shaft was limited to 4 ft. and the width under the coping to 3½ ft. The girders are anchored to the piers by sixteen 1¼-in. rods, placed in two rows 12 in. apart. The girders are thus practically relieved from restraint at intermediate supports. The outer ends of the approach spans are placed on roller nests.

The piers are supported on 50-ft. wood piles and the abutments on 25-ft. precast concrete piles 14 in. square. The wood piles, under the piers, were driven through about 20 ft. of sand and have 30 ft. of penetration into a clay stratum. No reliance is placed upon the sand, as it may be washed out during high water.

Concretes used were as follows: 2,000 lb. for the pier bases; 2,500 lb. for the abutments, pier shafts and sidewalks; 3,000 lb. for piles and 4,000 lb. for the floor system and girders. The 4,000-lb. concrete was mixed in the proportions of 94 : 160 : 282, dry mix, by weight. The water-cement ratio used was 4¾ gal. per sack of cement, the slump ranging from 6 to 8 in.

The concrete stress in the girders, due to flexure, was limited to 1,100 lb. per sq.in., and special consideration was given to provisions for shearing stress. Tension reinforcing in the girders was made up of seven layers of 1¼-in. square rods over supports to take care of negative moments. Four layers of 1¼-in. square rods were provided in the 120-ft. span, and five layers in the 85-ft. spans to take care of positive moments. Vertical stirrups (¾ and ⅝ in.), with spacing varied to meet the requirements, were placed in the middle 50 ft. of the main span and in the corresponding portion of the approach spans. Over the piers 1⅛-in. square inclined stirrups were hooked over and under 1¼-in. anchor rods.

The girder reactions were distributed over the pier tops by building out the bearings in the form of pilasters. The girder columns thus formed and the pier tops were reinforced with three interlocking spirals to provide for possible high stresses due to eccentricity in the application of the girder reactions.

The heavy reinforcing along the tops of the girders was supported on adjustable steel hangers carried by 6x6-in. wood frames resting in the falsework. These frames were spaced about 10 ft. apart along the girders and were made wide enough between the legs to allow proper clearance for the construction of girder side forms. The specifications called for the placing of all the above reinforcing before the erection of girder sides. The top steel was held in position by the hanger system during the placing of the concrete. The hanger rods were unscrewed and withdrawn from the concrete one day after the concrete had been placed.

For convenience in construction and to guard against excessive shrinkage stresses, concreting of the superstructure was divided into five pours. The first and second pour were 70-ft. sections over the two piers. The outer 50 ft. of the two 85-ft. spans was poured third and fourth, and the center 50 ft. of the channel span was poured last. Sixteen 1¼-in. inclined rods were placed through each girder construction joint, in addition to the steel provided to take care of design stresses. Construction joints were inclined on a slope of approximately 1 to 8 to insure compressive action in the joint.

The over-all length of the bridge is

370 ft. and the over-all width is 57 ft. It contains a total of 2,250 cu.yd. of concrete, of which about 950 cu.yd. is in the superstructure. The total form surface amounted to 75,000 sq.ft., and the total reinforcing steel to 314 tons. The low bid was $122,000, including removal of an old 250-ft. swing span and its foundations, and the contract was let for that amount.

The wearing surface is 2½-in. paving brick on a 1-in. sand cushion. The insulating value of this type of floor covering influenced its selection, as it will help in reducing expansion in the floor.

This work was done under the general direction of J. M. Nagle, city engineer. The design of the bridge and supervision of construction were under the personal direction of J. G. McKenzie, bridge engineer, with L. C. Wagner and the writer acting as principal assistants in the design and preparation of plans. Don Hall was the general contractor. All concrete used on the job was mixed in transit and delivered in the forms by a local material company.

Additional Vacuum Tank Solves Difficult Suction-Lift Problem

By Edward I. McCaffery
Sanborn and Bogert, Consulting Engineers, New York City

WHEN first installed, the automatic priming equipment on the pumps at the New Castle, N. Y., waterworks failed to remove enough air to keep the pumps primed at all times. An additional air trap was installed, which corrected the trouble. A severe priming problem was presented from the outset by the long suction line that had to be used.

The town's new water supply is taken directly from the Catskill Aqueduct carrying water to New York City. Sanitary regulations of the New York water department forbid any connections to the long conduit except through the arch, which made impossible any form of design to avoid a long suction line. Further, as the open end of the suction pipe would be inaccessible, a foot valve could not be used.

The normal flow line of the cut-and-cover aqueduct at the point of intake is at El. 365, 16 ft. above the invert. The center line of the two centrifugal pumps in the pumping station, 150 ft. away from the aqueduct, is at El. 374. About 15,000 ft. from the pumping station is a standpipe of 2-m.g. capacity, 25 ft. high, into which the pumps discharged. The water level, when the tank is full, is about at El. 700.

The pumping equipment consists of two 750-g.p.m. horizontal centrifugal pumps direct-connected to 100-hp. synchronous motors. The pumping units are automatically started and stopped by the level of the water in the tank as follows:

The priming system consists of a closed steel vacuum tank 30 in. in diameter and 6 ft. high. The bottom of the tank is connected to the blanked end of the 16-in. cast-iron suction header by a 4-in. pipe, so that water passes both pump suctions before entering the tank. The reason for locating the tank beyond rather than ahead of the pumps was to provide a vacuum where it would offset any tendency of the first pump to pull water away from the second. Two motor-operated vacuum pumps are connected by a 1-in. pipe to the top of the tank.

When the pumping station was tested, the pump nearest the aqueduct failed to retain its prime or pump any water when the second pump was started, unless the discharge valve of the second pump was slowly opened by hand. Even this method did not prove dependable.

Inspection revealed a large amount of air entering the suction line whenever the pumps were started. The first pump acted as an air trap and received the greater quantity of air. Every possible point where air might enter the suction line was inspected and made tight; the entire suction line outside the aqueduct was recalked; but the trouble persisted. Possibly air enters through an opening in the suction line inside the aqueduct, which was inaccessible for calking, or air is entrained in the Catskill water.

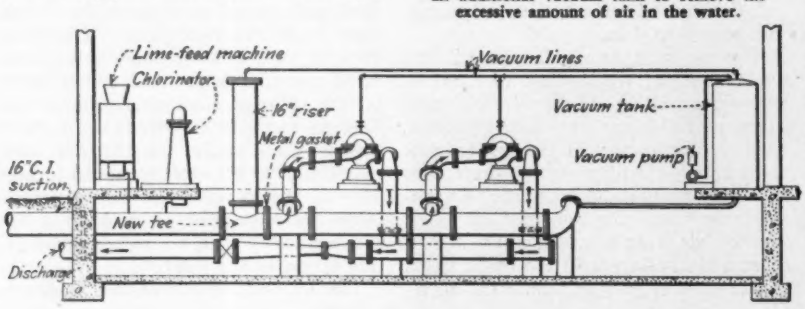
The other pump, which was used in the meantime, could be operated automatically but not entirely satisfactorily. The air entrained in the water delivered to consumers gave an unattractive milky appearance, causing many protests. The rumbling of the pump seemed to indicate that it was handling an abnormal quantity of entrained air.

To improve the situation, it was evident that more air must be removed. A 16-in. cast-iron tee was inserted in the suction line next to the tee leading to pump No. 1, and a 16-in. cast-iron flanged riser pipe about 7 ft. long with a bolted blank-flanged top was erected on this tee. This provides an additional vacuum tank. A 1-in. vacuum line was run from the top of the riser to the top of the vacuum tank. As an additional safeguard to keep air out of the pumps, a metal plate gasket was inserted in the flanges between the new tee and the tee connecting to pump No. 1. This gasket extends down into the waterway 4 in. to trap any air coming toward the pumps and divert it into the riser.

The addition of the new riser and metal gasket corrected the difficulty. Since their installation both pumps have been operating automatically without any priming troubles, and in addition, the appearance of the water delivered to consumers has been improved.

Charles H. Sells, Inc., Pleasantville, N. Y., is engineer to the water district, with James Hannan, Jr., in immediate charge. Sanborn and Bogert, New York City, acted as consulting engineers on the equipment of the pumping station, with the writer in direct charge.

Riser pipe built into the suction line formed an additional vacuum tank to remove the excessive amount of air in the water.



Massachusetts Planning Progress

Nearly 120 municipalities in Massachusetts have planning boards, but only 98 were sufficiently alive to report their membership to the state division of housing and planning, according to the last annual report. Some kind of zoning exists in 74 cities, and creditable improvement and enforcement is had in some places, but as a whole the state officials find that the record is not what it should be. Seekers after special privileges are as active as ever; zone changes under the guise of variations by the boards of appeal, spot-zoning by city governments and town meetings, and failure to enforce the law against violators are all too common. The report lists some problems on which little is done: noise, advertising signs, overhanging street signs, main highways through villages and the removal for sale of loam, sand, gravel and stone from vacant lots in attractive residential districts.

Boston Vehicle Tunnel Design and Construction—II

Combination of dump-cars, belt conveyors and pneumatic guns lines 240 ft. of tunnel, including floor and roof slabs, per six-day week—Concrete placed in six steps with five form sections—Lining work does not interfere with tunnel-driving

THE PLACING of a thin concrete lining shell within a tunnel section is always a difficult and expensive procedure. Collapsible steel forms, pneumatic placing machines and belt conveyors, the last a fairly new piece of equipment in the tunnel field, have greatly reduced the difficulties. Yet a speedy and efficient job can be obtained only by judicious use of available equipment. Concrete lining on the Boston traffic tunnel, described in the following article, is an outstanding example of the use of modern equipment in an ingenious plant arrangement. Once planted and organized, this concrete work has progressed swiftly with remarkable precision and smoothness. This article supplements one published in the issue of June 30 covering the design of the tunnel and driving procedure. —EDITOR.

CONCRETE LINING, 18 in. thick and 28 ft. in diameter, is being placed in the Boston-East Boston traffic tunnel at the rate of 240 ft. per six-hour day. This work includes floor and roof slabs. The concrete is placed in six progressive steps, using five traveling steel forms without interference to tunnel-driving progress. The lining plant is a combination of railroad dump-cars, belt conveyors and pneumatic guns, with the operation of each class of equipment synchronized with the others to obtain a fast steady output.

The lining was begun early in April, starting at the construction shaft at the East Boston end of the tunnel. At that time the compressed-air bulkhead had been advanced to its second position, leaving 2,400 ft. of tunnel under free air. By the time the concreting operations will have reached the bulkhead, the shield-driving will have been completed and the entire tunnel will be under normal air pressure. The muck conveyor belt, leading from the shield to the shaft (*ENR*, June 30, 1932, p. 917) operates through the steel forms without interference.

Fig. 1—Boston traffic tunnel before lining with concrete, showing outside lining of pressed-steel plates. Tracks and belt conveyor for muck are carried on temporary wood floor.

Six progressive steps

Concrete is being placed in six progressive steps, indicated in Fig. 2. The first pour is an invert section, without forms except along the sides. Next the side walls up to and including the floor slab are placed in what is known as form No. 1. The remainder of the lining is poured in three steps, as follows: form No. 2 takes the side-wall sections 6 ft. high above the floor slab; the remaining side-wall sections up to the roof slab are placed in form No. 3; and form No. 4 takes the crown section above the roof slab, this section being placed by the pneumatic process. Later form No. 5 is used for the roadway roof slab.

All concrete comes from a commercial central plant in trucks with 5-yd. agitator bodies. It is chuted down the ventilation shaft into a 5-yd. storage hopper set over the two narrow-gage railroad tracks, which are also used in the transportation of liner plates and grouting materials. Six-car trains of hopper dump-cars, hauled by storage-battery locomotives, handle the concrete from the storage hoppers. Pneumatic hammers are used to vibrate all steel forms.

Invert—Before a section of invert is poured, the timber platform or roadway carrying the tracks and belt conveyors is hung from the steel lining by cables to release the posts underneath. All pipe lines and wires are transferred to hanging supports on the under side of the platform. The timber roadway is above the permanent floor slab. Concrete for the invert section is dumped directly from the hopper cars through traps in the timber platforms. No top forms are required for the invert, as satisfactory results are obtained by using screeds. The invert is kept ahead of the remaining concrete pours, being advanced daily 35 to 100 ft.

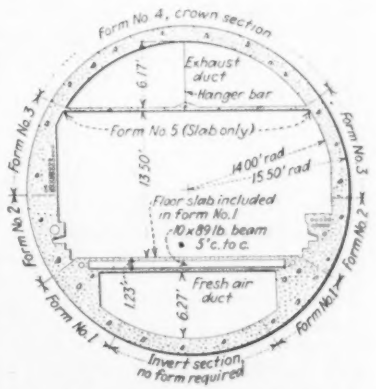


Fig. 2—Concrete lining and slab pours are made in six steps, using five form sections, as indicated in this diagram.

Lower Side Walls and Floor—The next pour includes the lower side walls and floor slab, which incases the steel floor beams. These steel beams are temporarily hung on longitudinal angle irons supported by the timber floor. Concrete for this pour is dumped directly from the hopper cars into form No. 1, the form being carried on rails set on the concrete invert. An 80-ft. form section is used, and this section is poured three times a week on alternate days. After the floor slab has set, the timber platform is removed, and the tracks and muck conveyor are transferred to the permanent floor, and pipe lines are dropped to the invert.

Upper Side Walls and Crown—The remainder of the lining is poured together in a form assembly carrying three 80-ft. steel form sections, Nos. 2, 3 and 4, in tandem, No. 2 being toward the shield. Form No. 2 includes the sidewalk and wall section 6 ft. above the floor slab; No. 3 includes the duct banks and walls up to the roof slab, and No. 4 carries the crown above the roof slab. The form assembly runs on rails resting on the concrete floor slab. Bracing of the forms is so arranged that it does not interfere with the operation of trains or the belt conveyor.

Concrete is dumped from the hopper cars onto a belt conveyor carried by a parabolic truss, leading to the front or shield end of the upper level of form No. 2. Here another belt, swiveled at its lower end, carries the concrete to four 35-cu.ft. hoppers set about the midpoint of the form. Concrete can be discharged into any one of the four hoppers by swinging the belt conveyor. The concrete to be used in form No. 2 is dumped into the two outside hoppers. These hoppers discharge into dump-cars traveling on rails along the outside edges of the upper level of the form. The cars are self-propelling by means of electric motors, powered from cable reels and dump directly into the form.

Concrete for forms 3 and 4 is dumped into the two center hoppers on form No. 2. From these hoppers it is carried in two cable cars running up a ramp to the upper level of form No. 3, the cars being pulled by an air hoist. The cars dump onto slope boards leading to the side walls of No. 3 form, from which the form is filled and also run to flat hoppers under the back end of form No. 3. These hoppers, which feed two ½-yd. pneumatic concrete guns, travel transversely across the form so as to dump directly into the guns.

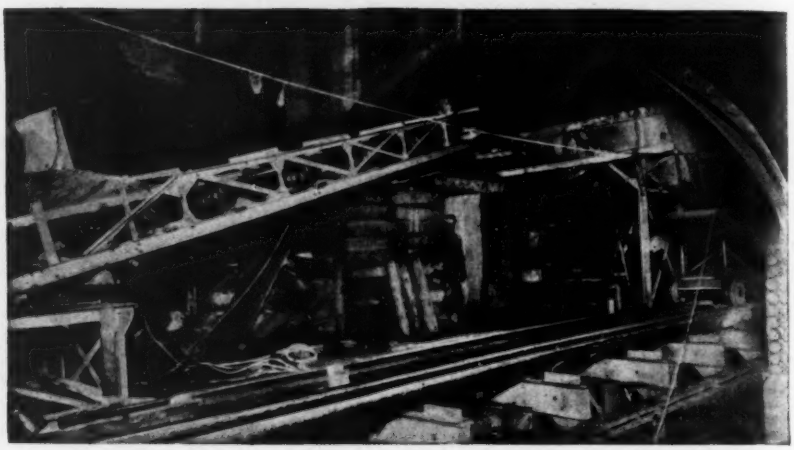


Fig. 3—Assembly of forms No. 2, 3 and 4 moving through ventilation shaft. View shows form No. 2 carrying pivoted belt conveyor leading to four hoppers in background. One of the two self-propelling dump-cars for distribution of concrete in form No. 2 can be seen at right of hoppers.

Each gun feeds five 6-in. header lines leading to ten riser pipes permanently set at 9-ft. intervals into the crown of form No. 4. Each gun moves transversely to connect onto any one of its five header pipes.

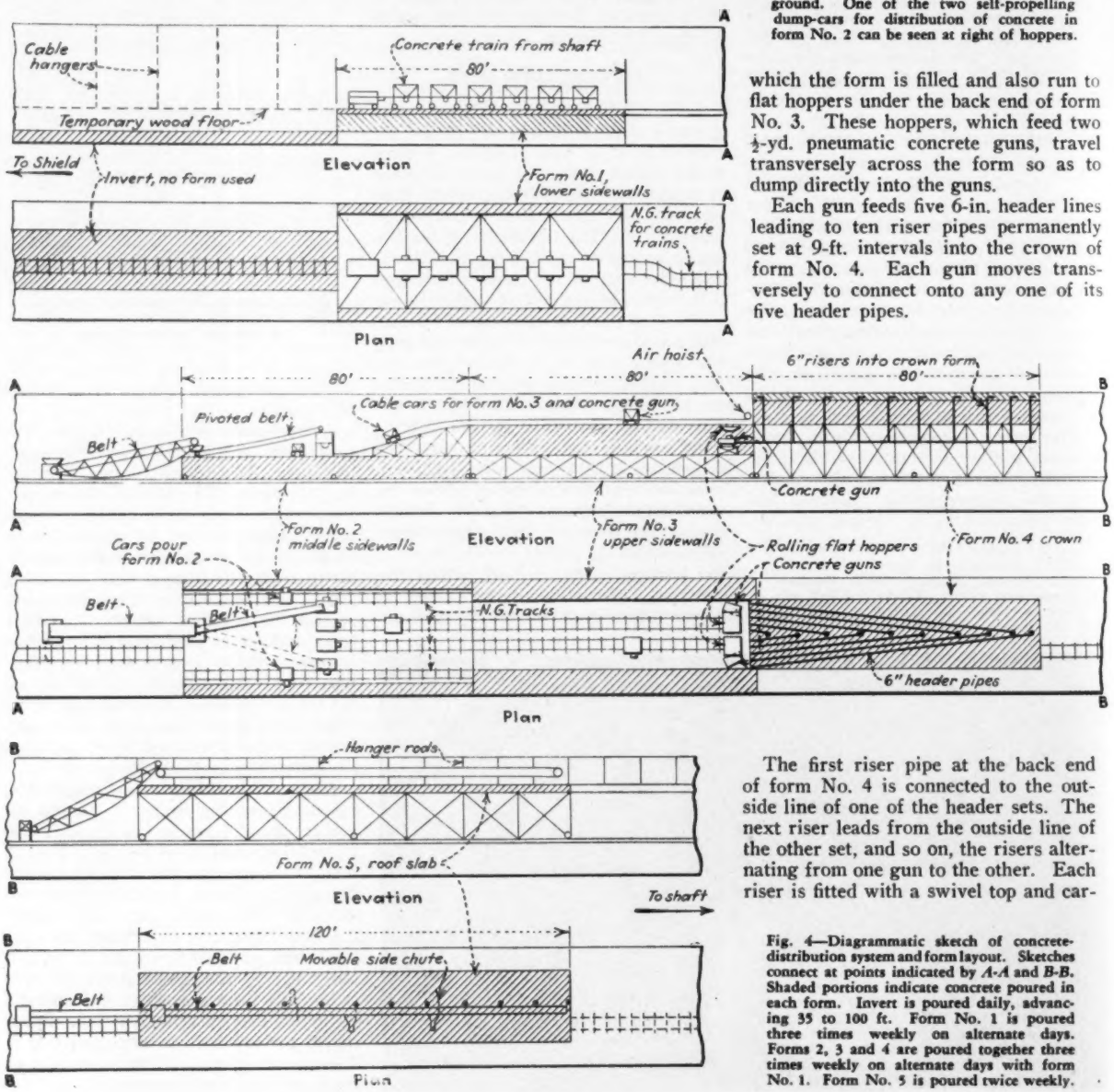


Fig. 4—Diagrammatic sketch of concrete-distribution system and form layout. Sketches connect at points indicated by *A-A* and *B-B*. Shaded portions indicate concrete poured in each form. Invert is poured daily, advancing 35 to 100 ft. Form No. 1 is poured three times weekly on alternate days. Forms 2, 3 and 4 are poured together three times weekly on alternate days with form No. 1. Form No. 5 is poured twice weekly.

The first riser pipe at the back end of form No. 4 is connected to the outside line of one of the header sets. The next riser leads from the outside line of the other set, and so on, the risers alternating from one gun to the other. Each riser is fitted with a swivel top and car-

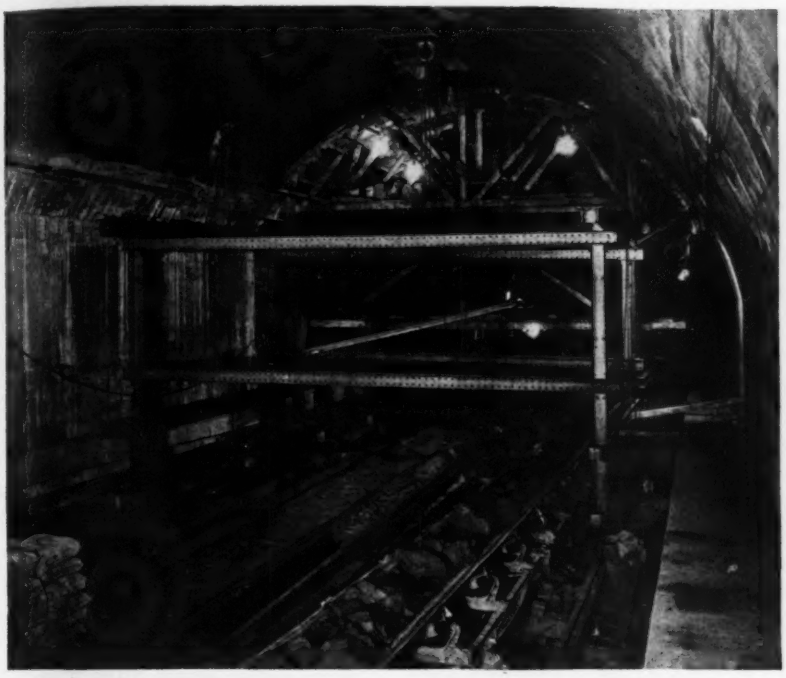


Fig. 5—Rear end of crown-section form No. 4. Belt conveyor, which handles muck from shield, travels through all forms without interference.

ries a short elbow nozzle that shoots concrete in a horizontal direction. The risers usually work in pairs, one feeding from each gun. At the start of filling a section of form one riser will be pointed toward one wall and the adjacent riser pointed toward the opposite wall, balancing the load as the forms fill up. When the pour nears the crown, the front one of the two risers is shut off until the back riser is swung around toward the back of the form to fill the top of the arch. After this portion of the form is filled, the riser is removed, the crown form section is placed, and the second riser completes the arch section to the rear. This operation is repeated, using the risers in pairs until the form is filled.

For safety and convenience an electrical signaling system has been installed between the riser pipes and the guns. When a riser is ready for concrete, a button is pushed, lighting a red signal at the gun end of the header pipe to which the riser corresponds. When the gun is ready to shoot through this pipe, the crew at the riser pipe is warned by another red light. Thus no unexpected charges of concrete catch the workmen unaware.

After each use of a pipe line, it is cleaned out by removing a flange at the junction of header and riser and blowing out the pipe by air. For this purpose a dummy gun is used, consisting of only a connection between the gun end of the header and a high-pressure air line.

Forms 2, 3 and 4 are poured three times a week on alternate days with form No. 1. The pours, aggregating 276 cu.yd., start at 4 p.m. and are usually completed in thirteen to fourteen hours. The procedure is to fill forms No. 2 and 4 together at first, leaving No. 3 to be filled last or whenever a tie-up occurs in the pneumatic placing equipment.

Roof Slab—The final concrete pour, for the thin reinforced roof slab beteen the roadway and exhaust-duct areas, is kept some distance behind the wall lining. The slab is poured twice a week, using a 120-ft. steel form known as form No. 5. Two belt conveyors handle the concrete for this form—one, carried by a parabolic truss, leading from the roadway to a point above the roof slab level, where it connects with a distribution belt running the full length of the form. Sliding stops and chutes take the concrete off this latter belt at any desired point and spread it over the slab area. Some hand-shoveling is required to fill the outside edges of the form. The hanger straps and center angle supports for the slab are shown in Fig. 3 and are erected from the form before concrete is placed.

Grouting—Plans call for a 1-in. grout pipe to be placed in the top eight segments of every lining ring. These pipes have a cast-iron elbow at the top or outside end and are fitted with a sleeve connection at the other end for connection with the grout line. A 1:2 cement and sand mixture is specified for grouting.

Contractor and personnel

The tunnel is being built by the Boston Transit Commission under the direction of Ernest R. Springer, chief engineer. Silas Mason Co. has the contract, with H. L. Myer, vice-president and general manager, in charge. A more complete personnel was given at the end of the article appearing June 30. The concrete-handling plant was designed by Mr. Myer. Blaw-Knox designed and furnished the steel forms for the job.

Removal of Sand-Bed Sludge and Its Sale for Fertilizer

SEWAGE SLUDGE from Imhoff tanks at Dayton, Ohio, is dried in eleven glass-covered beds with a total area of 105,600 sq.ft. The design was based on an assumed requirement of 0.4 sq.ft. per capita. Experiences in handling the sludge and preparing it for sale were told at the recent joint meeting at Rockford, Ill., of the Central States Sewage Works Association and the Illinois Association of Sanitary Districts by M. W. Tatlock, superintendent of sewage treatment. His observations led to the conclusion that any sludge containing 20 per cent solids can be removed from sand drying beds if necessary, but such operation is expensive. A large amount of labor is required, and it is necessary to replace large quantities of sand. Sludge containing less than 65 per cent moisture can be handled most economically.

In 1930 it was necessary to remove sludge from the sand beds as soon as possible. This resulted in a sand replacement of 5 in., whereas in 1931, when the sludge was dried more thoroughly, the sand replacement was reduced to 3 in. The cost of removal each year was $1.07 per square yard.

Sludge is forked from the sand into industrial cars and hauled 800 ft. to the sludge dump by a gasoline engine. At first, with a crew consisting of a locomotive operator, brakeman and six men, one bed could be cleaned per eight-hour day. Later a foreman who could oper-

SUMMARY OF OPERATING RECORD
DAYTON, OHIO, SLUDGE-DRYING BEDS, 1931

	Material Deposited on Drying Beds	Material Removed From Drying Beds
Total volume, thousand cu.ft.	1,388.5	297.4
Solids, per cent	4.8	37
Specific gravity	1.009	0.732
Total solids, thousand lb.	5,031.2	4,217.5
Volatile solids, per cent	58	55
Ether soluble, per cent	12	9
Total nitrogen, per cent	3.40	3.11
Depth, in.	9	1.6

ate the locomotive was employed, and fourteen-tined coal forks were substituted for the six-tined manure forks. These economies reduced the necessary labor to 24 man-hours per bed, reducing the cost 63 per cent.

Late in 1930 some sludge was left on the beds until it contained only 10 to 15 per cent moisture. It was then put through the cylinder of a wheat thresher, screened and put up in bags for sale. Talks to friends and luncheon clubs were then used to create a demand for its use on lawns and golf courses. In 1931 a hammer mill equipped with a cyclone blower and sacker was installed. Without great effort 60 tons was sold last fall. Sales are made at the plant or through agents assigned to definite territory. The sludge retails at $1 per 100 lb. up to half-ton lots, above which a wholesale rate of $15 per ton is charged. Agents pay $8.50 per ton. The demand now exceeds the supply. A 10x12-ft. hot plate was built of discarded manhole covers and old firebrick. It is fired by Imhoff gas. This outfit, made from junk, dries 1½ tons of sludge per hour and reduces the moisture from 40-50 per cent to 8-10 per cent.

A total of 475 tons had been sold up to May 10. It brought $4,793.35. To produce, it cost $1,789.50 for maintenance and supplies and $1,566.68 for labor, figuring operation and sales costs only. Unfilled orders for 200 tons are on hand to be delivered to tobacco growers, who obtained excellent results experimentally last year.

Model Tests Verify Design of Madden Dam Spillway

Extensive studies made in Colorado laboratory check design of sloped apron adopted to meet special conditions found at the toe of the dam

STUDIES to check the design of the spillway of the dam to be built on the Chagres River in the Panama Canal Zone to augment the power and water supply for the canal and to provide better control of floods were begun in May of last year and were carried forward during the summer and fall in connection with other model studies being conducted by the Bureau of Reclamation. Recently the results of the studies were summarized in a report to Governor Burgess of the Canal Zone. A summary of that report and its conclusions is given in the following. —EDITOR.

THE DAM forming the Madden Reservoir, which is being constructed on the Chagres River to store water for the Panama Canal, contains a gravity-section ogee spillway of 400 ft. net length. It is designed to take care of a discharge of 280,000 sec.-ft., and the drop from headwater to tailwater under these conditions is 124 ft. As the energy that must be dissipated is nearly 4,000,000 hp. and the velocity might reach 100 ft. per second, and since the river bottom is a rather soft limestone, careful study was necessary to insure that such a flood could be handled safely. At all discharges the height of the tailwater is too great to permit the hydraulic jump to form effectively on an apron at the level of the river bottom. This is a condition rarely encountered in dam design and required special treatment.

The preliminary design contemplated a horizontal apron 120 ft. wide at the bedrock level, surmounted at its downstream end by a dentated sill. At the maximum discharge the depth of water over the apron was nearly 80 ft., but the model tests on this type showed that the high-velocity water falling over the crest would dive to the floor of the pool and sweep along the apron with so little loss of energy that the sill at the end of the apron would be subjected to undesirable impact. The design finally developed had a sloping apron at such an elevation that the jump formed on it in an efficient manner at all discharges. This apron contained a considerable volume of masonry, but much of this was necessary to secure the required stability against sliding and earthquake stresses.

In addition to determining the best method of protecting against the destructive effect of the water pouring over the dam, special consideration was given to the design of the right-hand end of the apron where it approaches the curving bank of the river, to determine the minimum excavation necessary at this point. Studies were also made for the design of the training wall between the apron and the power house tailrace, to determine the pressures against the end walls of the spillway and of numerous other points entering into the design. Extensive observations were also made upon the discharge coefficients of the crest and of pressures on the face of the dam under the nappe.

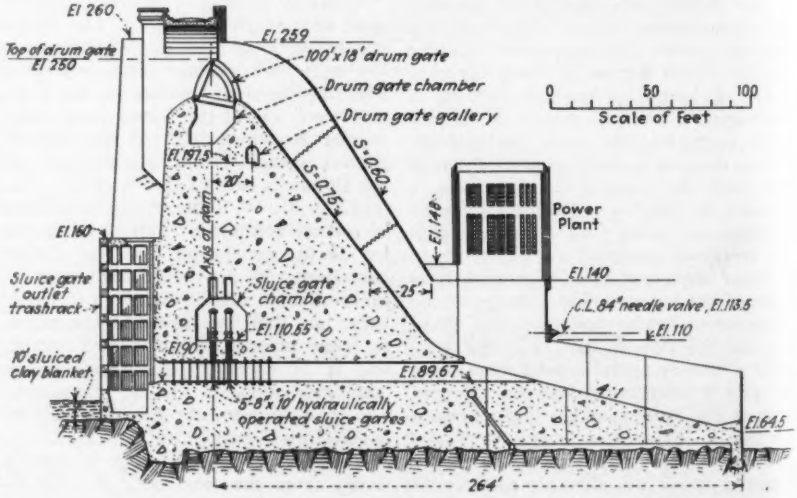
The hydraulic model studies were carried on in the hydraulics laboratory of the Colorado Agricultural College under the direction of the U. S. Bureau of Reclamation, R. R. Randolph, Jr., assistant engineer, Panama Canal, being in resident charge. The results of the tests have been summarzied in a report to the governor of the Panama Canal prepared by Mr. Randolph.

Conclusions drawn from tests

The hydraulic jump is very effective in dissipating the energy of the overflow, the resultant velocities after completion of the jump being little greater than those normally present in the river channel during a given flow if no dam were present.

The slope of spillway apron should not be made steeper than 1:4.

The elevation of the sloped apron, as shown in the present design, is such that the hydraulic jump will form well up on it at all stages of discharge over the spillway except at the lower flows when there is a tendency for the jump to move down the slope somewhat. Even then, the velocities leaving the end of the apron are comparatively small. It would



The spillway apron of Madden dam has a slope of 1 on 4 and is surmounted at its lower edge by a sloping-faced sill 6 ft. high.

be advantageous to lower the start of the slope slightly to pull the jump farther upstream. The apron may be lowered as much as 2.5 ft. without any appreciable change in other conditions of flow.

The thickened apron adds to the stability of the dam, affording a greater factor of safety against earthquake movements and decreasing the sliding factor.

The length of the jump, or distance downstream, required for full recovery varies as its magnitude, increasing with the discharge.

The highest velocities through the jump follow close to the floor until they are gradually retarded. The length of the spillway apron therefore should cover the range of velocity retardation until a point is reached where the velocities are low enough not to cause scour of the riverbed below.

The apron length may be shortened by placing a small sloped-face sill at the end to lift what velocities are present just clear of the riverbed below the apron until they are retarded in the natural course of the jump action. The sill, if too high, will receive terrific impact and also lift the high-velocity flow from the bottom to the surface, where retardation is much slower, and also will expose the river banks to erosive forces. If made only high enough to deflect the flow just off the riverbed, the velocity is quickly retarded by the static pressure of the tailwater.

The apron does not extend for the full length of the jump occurring at the higher flows but covers the range of great turmoil characteristic of the beginning. The velocity of water leaving the end of the apron may exceed 50 ft. per second at the maximum flow, but it will be lifted by the sill from the river bottom below until retarded in the jump. The hillside along the right bank, protruding across the line of flow, is, however, exposed to these velocities. The greater the length of apron the more protection is gained. It would seem advisable therefore to extend the apron at least 30 ft. farther downstream beyond the point indicated in the present design. Little or no additional cost is necessary, as the concrete can be taken from the apron by flattening its slope, which would be beneficial.

High side walls needed

The hydraulic jump should be inclosed by vertical sidewalls to a height, at least, following the rise in water surface through the jump, to prevent "washing out" by the inpour of the adjacent tailwater, says the report. It would be better if the walls could exclude the adjacent tailwater altogether. The walls should extend downstream until full recovery of the jump, where the water surface levels off to the same elevation as that of the adjacent tailwater.

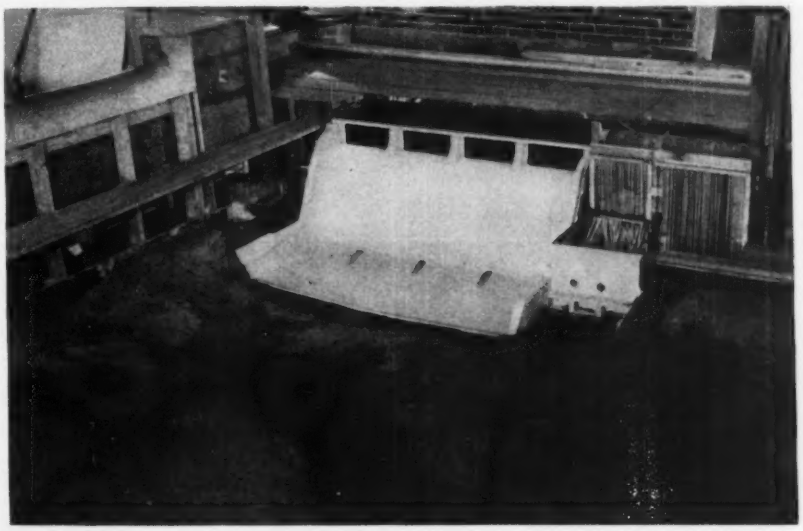
The power-house wall on the left side of the spillway should be raised to El. 128, which about follows the water surface through the jump at maximum discharge. There will still be some overpour onto the top of the jump, but no particular harm seems to result. The wall should be extended at least 30 ft. farther downstream than shown on the plans, to prevent an unbalanced condition caused by the cross-flow set up when the eddy occurs. This eddy or whirl is caused principally by the flow from the higher adjacent tailwater surface to the lower elevation of the water in the jump, but it is accentuated by the reverse flow of the river occurring along the left bank. The reverse flow upstream will pick up sand from the river bed below and deposit it in the exits of the power-house draft tubes, and the eddying will cause a pulsation of the tailwater, which is detrimental to the speed regulation of the turbines. The wall as finally recommended is of the least size that will afford ample protection at the maximum discharge, but it will cause absolute elimination of the eddy for flows up to 160,000 sec.-ft., corresponding to a 160-year flood.

With the protection of high walls on either side of the apron, there is a balanced and effective hydraulic jump produced at all flows. Although the apron rises on the right side and the river bank below protrudes out across the jump, there is no indication of a concentration of flow at that point, and the dissipation seems to be as effective there as on the left side. However, at the maximum flow of 280,000 sec.ft. the indications are that this hillside will be subjected to velocities as high as 35 ft. per second as an average over the whole area and 50 ft. per second just below the end of the apron; but if the bank washes back, a better jump will be formed and the velocities lessened. At flows up to about 150,000 sec.ft. the bank will be subjected to velocities less than 10 ft. per second.

It may be expected that the gravel deposits in the river channel and the earth overburden on the right bank will be washed a considerable distance downstream during a flow of any magnitude. These will deposit as a bar across the channel downstream, through which the receding floodwaters will cut a passage along the right bank. No detrimental effect on the performance of the jump from this charge was noticed in the tests.

Prototype performance similar to that of the model may be reasonably assured due to the well-established theory and existing proofs of the hydraulic jump action at various velocities and depths. The Madden dam model was built and tested with precision and care. The surfaces exposed to the flow of water were practically frictionless, so that any friction existing on the prototype structure will be on the safe side. Due to the sloping apron even at the maximum flow, the tailwater may be lowered as much as 20 ft. below normal before the jump sweeps off enough to increase the velocities dangerously at the end of the apron.

A dentated sill or any wall of concrete placed across the apron will, of course, check the velocity of the overflowing sheet of water. Such a sill, as was used in the original design with the apron at El. 60, would receive tremendous impact, as the high velocity carries to the floor with little retardation. This would call for a heavy sill structure with reinforcement and anchorage. The whole dependence for energy dissipation would then be placed on the sill, a small break in which



The model to a scale of 1 in. equaling 6 ft. reproduced the spillway and power house, together with the sluiceways through the spillway and needle valves discharging through the power house, also the river channel for some distance below the dam.

would endanger the entire scheme. In the tests the dentated sill prevented any serious erosion from occurring below the apron, but a vertical-faced solid sill of lesser height was almost as effective.

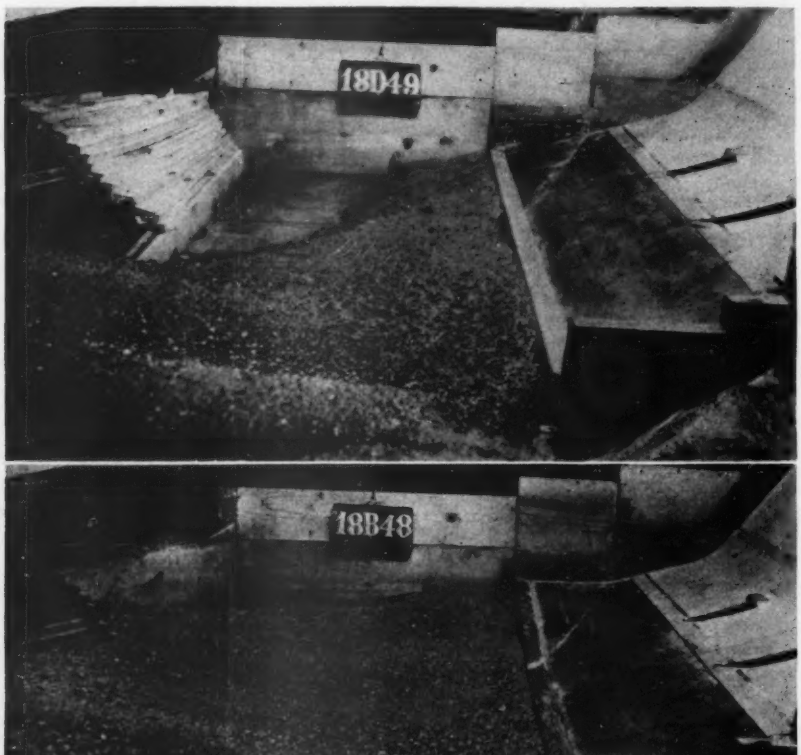
Spillway design satisfactory

The discharge capacity of the crest is ample. For a maximum pond elevation of 263 the crest will discharge better than 255,000 sec.-ft., and with the capacity of the needle valves and sluices at 30,000 sec.ft. the requirement of 280,000 sec.-ft. discharge is exceeded. However, with the drum gates raised to their maximum position at El. 250 and the pond at El. 263, the flow can only be throttled to 70,000 sec.-ft. The pond must recede to El. 260 or less before the flow can be regulated to 50,000 sec.-ft.

There is a vacuum developed on the downstream face of the crest amounting to about 12 ft. of water at the maximum point for a head of 31 ft. over the crest. This, presumably, has been taken into account in the stability design. Pressures on the upstream face near the top decrease as the gate is lowered, under a given head. This means that the intake for the drum-gate control float will have to be located at a point in the bulkhead face away from the spillway drawdown.

With a deflecting lip of the proper radius over the sluice openings through the face of the dam, the overflow from the spillway is deflected tangentially enough so as not to cause direct impact on the floor or the sluiceway. However, for all stages of flow a piezometer in the closed sluice conduit indicated a pressure showing that the jet from the deflector is depressed by the weight of the tailwater over it. With no tailwater over it there was a vacuum in the closed conduit, and indications were that it would take a 3½-ft.-diameter pipe to aerate the jet so that it would leap entirely clear of the floor. No concentration of flow or disturbance to the jump performance is caused by the sluice openings through the face of the spillway.

The drum gates should be operated simultaneously for the best jump performance. When one or two gates are operated separately the jump on the apron is to an extent drowned out by the overpour of the adjacent tailwater, and a concentration results which causes dangerous erosion at the end of the apron.



Studies were made of the best way to prevent excessive erosion in the turn of the channel just below the dam. With an apron of uniform slope throughout its length, considerable erosion was indicated, but with the right-hand end flattened and with the facing bank cut back no serious erosion was indicated. Flattening of the end of the apron is provided for in the present design.

Apron extension

A fuller statement as to the apron extension recommended in the preceding conclusions is given in the body of the report. It is there stated that the extension of the apron and the power-house side wall downstream 30 ft. from the present design will add greatly to the amount of protection afforded the riverbed and banks. Its value would far exceed that of any other comparatively small alteration that could be made to the design. Little, if any, additional cost would result as the concrete for this extension can be furnished by lowering the slope of the main apron at the upper end. It would be beneficial to the hydraulic jump performance to lower the apron at its upper end and to flatten the slope, especially for the lower stages of flow. The additional length will bring the apron to the end of the power-house wall and make the design more consistent.

The model tests herein described were carried out by R. R. Randolph, Jr., assistant engineer, under the general direction of E. W. Lane, research engineer, U. S. Bureau of Reclamation, who was in charge of other tests for the bureau being carried out in the same laboratory. The design of the dam was made in the Denver office of the Reclamation Bureau by E. S. Randolph, designing engineer of the Panama Canal, under the direction of J. L. Savage and R. F. Walter.

Germany to Build 300,000 Houses Annually

Some 300,000 dwellings will be constructed annually in Germany, if plans now under study by building authorities are executed, according to a report to the foreign construction division of the U. S. Department of Commerce from its trade commissioner in Berlin. It is officially estimated that about 250,000 new dwellings or apartments were constructed in 1930, while in 1931 dwelling construction was somewhere around the 150,000 mark, indicating that the housing shortage, as a result of the crisis, is becoming more acute. No construction is needed in industry, it is generally conceded, the report stated, as there is believed to be a large excess of industrial plant construction as well as equipment.

Unemployment in the building industry, which is now at a peak of 90 per cent, will probably be increased during the current year, the report also stated. Workmen in the construction field were employed only an average of 26 weeks in 1930, and in 1931 an average of sixteen weeks.

Building Mountain Highways in the Big Smokies

Skirting highways and across-park road built by adjoining states is first step in system of roads and trails for Great Smoky Mountain National Park

CREATION of the Great Smoky Mountain National Park, covering an area of about 670 square miles of rugged mountainous country in eastern Tennessee and western North Carolina, has presented various engineering problems, among which the provision of highways was the first that had to be solved. Most of the long narrow park area lies above 4,000 ft. in elevation, with numerous peaks close to 6,500 ft. in height. Much of the area is virgin timber. All of it was practically inaccessible prior to the adoption of the park plan.

Included in the terms under which the federal government agreed to accept the area from the two states and establish it as a national park were provisions that both states would make extensive improvements in their highways adjacent to the park. The states further agreed to build two highways skirting the park and one directly across it near the middle.

These three highways are now largely finished. They form interconnections between the systems of the two states and also serve as the main stems of an extensive layout of roads that the federal government will build to give access to all unrestricted parts of the park. Many miles of trails and paths will supplement these roads.

Tennessee's program for highway improvements in and adjacent to the park is nearly completed. North Carolina also will have completed her part of the highway-improvement agreement soon, except for some changes in her system on main stems near the park. Already motor traffic is able to enter the park from several directions.

Estimates of the probable traffic to be handled into and through the park area, prepared by the National Park Service of the U. S. Department of Interior, indicate a volume far in excess of that enjoyed by any other national park. Last season, with the roads on the Tennessee side partly finished, some 155,000 people entered the totally unimproved park area. In the near future it is anticipated that more than 2,000,000 visitors will have to be handled in motor cars annually, and eventually a much larger number. The fact that the Yellowstone National Park in 1931 had less than 400,000 visitors gives an idea of the comparative traffic problem.

Dumping this volume of traffic into a rugged mountain country that had no roads prior to the conception of the park plan presents various engineering problems. While the highways came first in the program of improvement, plans for the provision of ample supplies of potable water, protection of the numerous exceptionally beautiful mountain streams in the area against pollution and sanitation in general are problems being solved. At the same time locations are being studied for primary resort centers, camps and other facilities for handling so many people in a section where there are no existing services, with rail transportation and urban centers rather distant.

Accompanying photographs made during the grading of a 12-mile section of the cross-park highway, which recently was completed by the North Carolina State Highway Commission, give an idea of the character of the country traversed and the conditions met. On this 12-mile section the ruling grade is 8 per cent, and the maximum curvature is 38 deg. The finished grade is 24 ft. wide both in cuts and on fills, with an 18-ft. width of traffic-bound surfacing. All curves are widened and superelevated for 45 miles per hour.

In spite of the broken character of the country, an exceptionally good alignment was secured. Special efforts were made to get the best possible visibility. This was considered necessary not merely because the volume of traffic will be comparatively heavy for a mountain road but more specially because most of the drivers using the road will be new to local conditions.

At the summit of the mountains the cross-park highway reaches an elevation of 5,063 ft., which is believed to be the highest point on a state highway system road east of the Rockies.

North Carolina handled the grading of the 12-mile section of the cross-park road with its own forces and equipment, under L. R. Ames, state highway engineer, and J. C. Walker, engineer in charge of the division in which the park is located. B. S. Marsh was resident engineer on the project. The surfacing of the 12-mile section was done under contract by Nello L. Teer, of Durham, N. C.

A grading unit on the new highway constructed across Great Smoky Mountain National Park.

How Can City Costs Be Lowered?

A Public Administrator's Answer

II—For Fundamental Gains: Modernize Governmental Structure

By Clarence E. Ridley
Executive Director, International City Managers' Association, Chicago, Ill.

THE FIRST of Mr. Ridley's two articles appeared last week and described the moves that could be made immediately to bring about a reduction in municipal costs. In it he pointed out that it is dangerous and unwise to attempt to economize by discontinuing or drastically curtailing municipal services, but that there is great opportunity for saving by improving the efficiency of operations. Specific recommendations were made as to how this end should be achieved. In this concluding article more basic economies are considered. They depend in large part upon a modernization of local government structure to remove the legal and political handicaps to the development of administrative effectiveness. Although some of the moves recommended by Mr. Ridley would require legislative action, many are completely within the powers of the existing city governments to accomplish. —EDITOR.

MATERIAL economies in the operation of local government can be effected by improving the efficiency of administrative practices, but serious handicaps are placed in the way of such efforts by unwieldy governmental structures and unwise traditions of local-government policy. To achieve any basic reductions in the cost of municipal activities, it will first be necessary to view with a critical mind the established framework within which city departments must function, and then remove, by law if need be, the obstacles to effective and economical administration.

The problem resolves itself into one of eliminating the real "fads and frills," such as overlapping governmental units, duplication of effort, the fee system and the spoils system, and substituting therefor the most approved methods of administrative organization and procedure. Reduction in the cost of government is a permanent and continuous job, with results dependent upon a thorough study of the fundamentals of organization and procedure and action based on such study.

There are far too many local governments

At the start, let us examine merely the number of local governments we have. It has been estimated by Prof. Simeon E. Leland, of the University of Chicago, that the elimination of overlapping governmental units in the United States could reduce the total cost at least one-fourth without lowering the quality or quantity of service. According to Professor Leland, the number of governments maintained in this country is between 250,000 and 750,000. In Illinois, for example, there is one governmental unit for every 473 people; and for the area excluding Cook County there is one governmental body for every 263 people. This complex of political units involves every conceivable type of waste, according to Professor Leland, who, in an address before a meeting of the economics section of the Illinois State Academy of Science on May 6, 1932, said:

"The duplication of services that is obviously involved is less serious than the inability properly to perform certain functions or to determine what services are wanted or which should be provided. The maintenance of uniform, standardized or coordinated service is impossible. Some areas are occupied by so many political units that the services cannot be properly dovetailed; others have so few people that it is a form of economic folly for them to maintain separate or independent units of government; some have such small territorial dimensions that they should certainly be attached to other units. The lack of size or population in many subdivisions prevents efficient management, renders impossible the economical expenditure of funds or the wise acquisition of public property, makes difficult the employment of competent personnel, aggravates the problem of adequate financing and impedes the coordination of services in a single territory. On the other hand, the multiplicity of territorial units tends to increase the number and variety of political party organizations, spoils, jobs and graft, especially if the many territorial units are supplemented by overlapping and duplicating functional or *ad hoc* agencies. This condition not only increases waste by the loss through duplication of services, personnel, equipment and public property but prevents coordinated planning, the establishment of accepted standards of service, and the proper apportionment, control and budgeting of public funds. It maximizes political irresponsibility, makes it impossible for the electorate wisely to select its officials, contributing in every possible way to the development of machine-controlled politics, corruption and inefficiency."

With modern transportation and communication there is no longer any reason for so many counties and special districts. This is being realized in many parts of the country, and a few progressive communities have begun to consolidate their governments. This movement will probably gain momentum rapidly. The Mississippi Research Commission, in its recent report to the legislature, recommended a series of county consolidations that would abolish 19 of the 82 counties in the state. The Missouri committee of American Engineering Council has recommended that the 114 counties of Missouri be consolidated into 40 and that county managers be appointed in the larger units. County-manager enabling acts have been adopted in Montana and Virginia, and state-wide studies of county government have been inaugurated or recently completed in a number of states, including California, Illinois, Michigan, New Hampshire, North Carolina, Missouri and Ohio. City-county consolidation, especially in the more thickly populated sections of the country, would result in large economies. Undoubtedly this field offers great possibilities for making local government less costly.

Important savings can be made if adjoining counties or cities are permitted, as they are in Virginia, to employ a joint purchasing agent, joint county road manager or road engineer, joint health officer, or any other administrative officer. Small cities within a compact area may be financially unable to maintain a regular staff of technical advisers in legal, engineering and financial matters. They should consider a plan whereby one competent engineer and one attorney would give full-time service to several cities.

Such a scheme is already practiced in a number of cities in Massachusetts. In Virginia the Institute of Public Administration has recommended the consolidation of health and public-welfare functions for the city of Williamsburg, William and Mary College, two small towns and three counties. Such a procedure is less expensive than the employment of staff workers on a fee basis.

Even within a single governmental unit a number of departments may be found doing the same kind of work. For example, the park and public-works departments may both be doing street-repair work that could be combined in one department. The maintenance services of the sewer, street-cleaning and highway-repair divisions may be consolidated to advantage.

Again, a study of various municipal activities may reveal that some work should be carried on by private agencies or by the county or state government. For instance, in Detroit it is planned to

ask the state to take over the operation of the house of correction, and the county to take over the operation of the tuberculosis sanitarium. The activities of townships should be transferred to the county, and perhaps some county and municipal functions should be transferred to the state.

Personnel policies need improvement

However, the advantages of a modernized form of organization can be entirely lost if government is to be staffed with incompetent men. It is safe to say that the patronage system has been one of the main causes of the high cost of government. Not only does the patronage system have a disastrous effect on the morale of city employees, but it also causes distrust or lack of confidence in government on the part of the people at large. This in turn discourages citizens from voting and young people from considering the public service as a career. Consequently the important positions in city government are often held by those who have a selfish interest. Ordinarily they are paid salaries incommensurate with the responsibilities of the position, and the temptation is great to find other means of increasing their incomes. It is in these higher positions in the public service that the city needs to put most emphasis. It is at the top where large economies are possible. At present, competent men are not attracted because the pay is inadequate.

While the merit system is already in operation in many cities, it needs to be further developed and more adequately enforced. During the depression there has been a widespread tendency to discharge trained and expert workers in order to retain the old-time spoilsman or to make places for local unemployed men.

It is the responsibility of the chief administrator to make the municipal service attractive to the best talent by making appointments on the basis of ability and training and by adopting a comprehensive personnel program. Such a program must include proper recruiting procedure, sound advancement and promotion policies, training of employees and retirement under a pension system. Attention also must be given to such matters as hours of work, attendance, leaves of absence (annual, sick and special), transfers, removals, suspensions and morale. A great deal remains to be done in developing the science of personnel administration, but as a minimum the entire personnel system should be made an integral part of the administration under a trained personnel director appointed by the city manager or mayor. It is in this field that some of the most important economies can be effected.

Many state universities and state municipal leagues have established schools for police, firemen, finance officers and other local officials. City officials should encourage employees to attend such schools, for the result will be better service to the public, the development of a professional attitude and the building up of an *esprit de corps* in the public service.

Selective reduction of staff

The very need for lower costs can be turned to permanent advantage if it is made the occasion for rigid grading of the present personnel. Blanket cuts as a means of reducing the public payroll are justified only when other means of reducing expenditures have failed. According to Fred Telford (*Public Management*, March, 1932, p. 85), it is possible to reduce the payroll in many cities as much as 10, 15 or 20 per cent without reducing pay levels, if a selective policy of pruning is adopted.

EFFICIENT CITY ADMINISTRATION REQUIRES:

Fewer governmental units.
Enlistment of competent personnel.
Effective budget administration.
Proper fiscal calendar.
Adequate financial planning.
Coordination of departmental activities.
Utilization of governmental research.

In the governmental jurisdictions where this has been done the financial authorities have estimated as nearly as possible what the total payroll should be and have allowed the personnel authorities to tell them how that objective could be reached. The personnel directors have then insisted upon the classification of positions as the first step in the retrenchment program. The second step has been the establishment of rates of pay for each class of positions, based on the duties performed. The third step is to obtain some form of service rating that accurately reflects the performance on the job of each officer and employee in the service.

These three steps merely provide the management with the facts necessary for intelligent action. It will be found that some employees should be removed from the service because of the poor quality of their work. Their positions will be left vacant and their duties consolidated with those of other positions. Because of the kind and quality of work that certain other employees are doing there may be a large or small reduction of pay for them, but doubtless the majority will be giving average service so that their pay need not be disturbed. However, a few who are doing work of high quality and outstanding volume should receive increases because it will pay the city to provide them.

The experience of the Bureau of Public Personnel Administration is that the separation from the payroll of persons who are a net liability and an adjustment of pay in the manner that has been indicated usually results in a net reduction of the payroll from 7 to 10 per cent in cities that have been well managed, and from 20 to 25 per cent in those where the management has been markedly inefficient or overridden by the spoils system. By classifying positions and standardizing pay Oakland, Calif., recently reduced the annual salary budget $100,000.

Other means of reducing the total payroll budget include leaving vacancies unfilled, consolidation and elimination of positions, retirement of older employees, more rigid supervision and installation of mechanical equipment.

There are many offices, such as sheriff, delinquent-tax collector and others, which carry large fees in the way of compensation. For instance, in 1931 a delinquent-tax collector in a Pennsylvania county received $83,000 in fees. The Virgina General Assembly recently authorized the Virginia Commission on County Government to make a study of the fee system in that state, with a view to substituting salaried offices.

Budgeting should be more effective

Having given our attention to the subjects of structural reformation and personnel improvement, let us now consider administrative policies in their effect upon economy. Of these, the most vitally important is the financial administration.

Financial responsibility should be fixed in the finance director or controller, who should see that there is a scientific budget system. It should include: executive allotments and work programs; accrual accounting, an up-to-date system of assessing property for taxation; sound methods of tax administration and collection; controlled inventories of the city's supplies, materials, equipment and real estate; periodic reports to the public, including an operating statement and balance sheet; an operation audit; centralized purchasing; unit costs for measuring services; a long-time financial plan and approved bond practices.

The fiscal calendar should be revised to place in the proper relationships all the steps of estimating expenditures, making appropriations, levying taxes and collecting revenue. A detailed study should be made of miscellaneous revenues with a view to revising the tax system to adapt it to modern social and economic conditions. In this connection the report of the New York State Commission for the Revision of the Tax Laws should be of interest (*Legislative Document*, 1932, No. 77). As an example, the California legislature has recently created a permanent state tax-research bureau to conduct investigations and report to the legislature on the subject of taxation and make suggestions for needed changes.

A budget that is not enforced is mean-

ingless. The budget officer should keep a record by months of the allotments made to each department under each budget classification. All requisitions, payrolls and bills should go through the budget office before they go to the purchasing agent or controller. The budget officer should encumber the allotment, and if the proposed purchase of an object exceeds the department head's estimate for the month for that object, he should be consulted as to the necessity for the immediate purchase. If the purchase is still considered necessary the requisition should go through with the understanding that a saving of equal amount will be made in the ensuing month.

On the first of each month the chief administrator should be furnished statements showing for each department the actual receipts and expenditures compared with estimates made at the beginning of the period, and the unexpended balance of the year's total. If expenditures have exceeded the estimates, or if the actual revenues are lower than estimated, the budget officer or controller, department head and chief administrator should revise the estimated expenditures for future months to avoid a deficit at the end of the period. The "controller" function of continuous audit of expenditures should be adequately developed; in other words, there should be a current criticism of all expenditures.

The city's chief financial officer should control the accounting practices of all departments, boards and commissions, and he should conduct the necessary internal audit to check and examine the financial procedures and methods of the various departments.

The handling of insurance on buildings and equipment should also be centralized, preferably under the controller or purchasing agent. Insurable values should be determined in cooperation with department heads. A revaluation of buildings may reveal that some property is overinsured and that standard rates of coverage should be adopted for each group or type of buildings. Consideration should be given to the desirability of the city assuming its own fire risk where property is not subject to the usual fire hazards. Many of the larger cities find it more economical to carry no fire insurance.

Financial planning is necessary

The borrowing policy of the city should be governed by a long-term capital-expenditure program. Peak periods of debt payment should be avoided by careful planning, and items that are of a recurring nature should be included in the current budget if possible. Long-term planning of this nature will aid the city in keeping its credit at a high level, obtain the best possible results from the available funds and bring about a proper balance of expenditures for each type of improvement. With a definite program for carrying out public improvements in accordance with the city plan and the city's ability to pay, the tax burden may then be safely equalized over a long period.

One specific suggestion for economy in city planning is that cities should refuse to approve plans for land subdivisions until the construction of paving and extension of utilities are assured by the developer.

Economies can be made in purchasing

A great deal of money is spent annually for materials used in the operation of city departments, and it is reasonable to expect favorable terms for such large orders. Every city should have a central purchasing agent, and at times a number of governmental units within a small area may effect large savings by consolidating their purchases of standard commodities. For instance, the city of Cincinnati, Hamilton County and the school district in Cincinnati are planning a joint purchase of coal at about $100,000 less than would have to be paid if the same total quantity were to be purchased separately. Centralized purchasing in 1931 saved the city of Milwaukee $847,778, or 15 per cent of the total purchases, while cash discounts accounted for an additional saving of $54,774.

It is important that standard specifications be developed, that proper procedure for advertising and the letting of contracts be followed, and that adequate testing and inspection of deliveries both as to quantity and quality be established. If possible, a central storage system should be established, and adequate control should be exercised over stores with a view to keeping down the amount of the investment.

Economies in management

It is clear that there will be no adequate basis for intelligent criticism of public expenditures until proper standards of performance are developed for comparison. Considerable work of this nature has been done in two fields—street cleaning and police protection. The installation of the standards and records thus developed will enable the administrator to exercise more adequate control over operations and to know what the proper expenditure should be for a given operation, with the result that more effective service can be rendered at lower cost.

To obtain best results, the operations of the various city departments must be coordinated. In addition to being chief administrator, the mayor or manager should also be the chief coordinator in the smaller cities. In the large cities this work might be the responsibility of the assistant to the chief administrator or to the budget officer or controller. Such an officer should have considerable authority and should be responsible for exercising general supervision over all interdepartmental business. He might also assist in economical management by suggesting possible elimination or consolidation of overlapping activities, by arranging departmental transfers of surplus property, by developing centralized filing and record systems, by devising standard forms, by studying methods and office practices, by coordinating the control of all land and buildings belonging to the city and by working toward the coordination of activities between the city and county government. Without such coordination the departments are likely to operate with little or no concern for the common good.

So far as possible, the administrator must see that there is a clear separation between line and staff functions and that there are not too many departments reporting directly to him. He must look at administrative organization as something more than charts and diagrams; he will consider it a working relationship between individuals who are working to accomplish certain results, and as such will organize the administrative structure from the bottom up, working out relationships and grouping them accordingly, rather than considering departmental lines as rigid and inviolable (John B. Blandford, Jr., "Organization Management in City Administration," *City Manager Yearbook*, 1932, pp. 133-139).

Research in administration

No public administrator, no matter how capable he may be, can remain thoroughly qualified unless he keeps abreast of the rapid advances being made in the technique of municipal administration. Nor will he remain competent to solve the problems of his city unless he studies them through the constant research of trained assistants. Research is a staff function of the greatest importance, not only as an aid in the improvement of administration but also as a guide to determining policies.

Research work might well be carried on under the direction of the budget officer; or if there is an independent

COMPETENT PUBLIC SERVANTS SHOULD COMMAND PRESTIGE

Taxpayers as well as city officials should work toward the professionalization of the public service, so that qualified individuals will be encouraged to train for and enter the various administrative branches of the service with a view to making it their life work. Not only should the pay be adequate but a certain prestige should be built up around the public service. Certainly a continuation of the scoffing and sneering at government will not aid toward this end; on the contrary, it constitutes a certain way to more costly and inefficient public service.

bureau of municipal research, the budget officer as an agent of the chief administrator could act as the liaison officer between the city and the research bureau. In organizing and administering the various municipal activities the administrator will find the surveys and recommendations of an impartial outside research bureau of great value. If management is to be in any sense scientific, it is essential that administrative decisions be based on investigation and analysis of facts rather than upon arbitrary and hastily issued orders. Constructive economy is not possible without research.

City officials will profit from the use of the informational and advisory services offered by the federal government, state governments and the state municipal leagues, as well as those of the national associations of public officials and the various semi-public and private organizations. (See Paul V. Betters, "Federal Services to Municipal Governments," Publication No. 24, Municipal Administration Service, 1931.) Officials also should keep in touch with the more important developments in the methods and technique of local government administration by subscribing to general municipal journals and specialized periodicals. Many cities find it a good investment to defray the expenses of certain officers in attending the state and national conferences held annually on important governmental problems. By availing themselves of these many services the administrators, department heads and councilmen will broaden their vision and obtain new ideas for reducing expenditures and increasing the effectiveness of the services rendered in their own cities.

Cost reduction depends on improved administration

To summarize, it is only by the provision of a sound organic structure for local governments and enlightened policies of administration that a high degree of efficiency in municipal activity can be made possible. Lines of authority and responsibility must be made clear, both as between several municipal departments and various governmental jurisdictions. Unification of effort can be carried a considerable way by simple devices now available to elected officials, although complete consolidations require legislative action activated by organized public opinion.

For their own benefit, the taxpayers as well as the city officials should work toward the professionalization of the public service so that qualified individuals will be encouraged to train for and enter the various administrative branches of the service with a view to making it their life work. Not only should the pay be adequate, but a certain prestige should be built up around the public service. Certainly a continuation of the scoffing and sneering at government will not aid toward this end; on the contrary it constitutes a certain way to more costly and inefficient public service.

* * *

There is no denying the fact that expenditures can be reduced; in fact, they are being cut. (See "Reducing Municipal Expenditures," in *Public Management*, April, May and June, 1932, containing reports from 104 cities on how expenditures have been reduced. For reductions in 25 large cities, see Harry H. Freeman, "How American Cities Are Retrenching in Time of Depression," *National Municipal Review*, April, 1932, pp. 267-81.) But it is not likely that the total cost of government will stay down for long, because experience indicates that as government becomes more effective in conducting its various activities the demand for the extension of governmental services increases. It should be remembered that a government itself does not automatically take on more activities; they are assumed at the behest of the people or their elected representatives.

As to indiscriminate budget cutting, it is essential that budget cuts be made only after careful study on the basis of proper research. Otherwise, it is likely that unwise reductions will be made that result only in enhancing future public costs or that transfer expenditures to private purses at a loss to the citizen. In other words, the reduction in expenditures must be constructive and must avoid impairing the present standard of service.

The business man who is excited by scandalous examples of waste by some governments fails to see that there are many other city governments that are operating at very near maximum efficiency. Such a person sharpens his shears to cut all budgets regardless of the services rendered and denounces all public employees as being corrupt, exempting only the members of his own class who hide behind the corrupt political schemers. It should be recognized that the level of governmental service has steadily improved, that American cities as a class are no longer the most corrupt and most poorly governed in the world, and that the standard of political morality has steadily risen until, in many respects, it is higher than that of private business.

The present crisis offers an excellent opportunity for taxpayers, as well as city officials, to take a constructive attitude toward their local governments, with a view toward improving governmental structure and organization, raising the administration of municipal services to high standards and, at the same time, reducing expenditures. Constructive economy should be practiced in periods of prosperity as well as during depressions. But a pruning-knife or a scalpel is a better instrument of economy than a broad-ax or a buzz-saw.

CITY GOVERNMENT AND THE BUSINESS MAN

The business man who is excited by scandalous examples of waste by some governments fails to see that there are many other city governments that are operating very near maximum efficiency. Such a person sharpens his shears to cut all budgets regardless of the services rendered and denounces all public employees as being corrupt, exempting only the members of his own class who hide behind the corrupt political schemers. It should be recognized that the level of governmental service has steadily improved, that American cities as a class are no longer the most corrupt and poorly governed in the world and that the standard of political morality has steadily risen until, in many respects, it is higher than that of private business.

Autoclaving Proves Unsuitable for Testing Aggregate Durability

Because usual methods for testing concrete aggregate durability require so much time as to be unusable, an autoclave test, similar to the one sometimes used as a soundness test for cement, has been studied at the Bureau of Standards at Washington. The Bureau of Public Roads cooperated by furnishing fourteen samples of aggregates, including three of dolomite, which had been judged unsuited for use in concrete pavements. These were submitted to two treatments in steam at a pressure of 600 lb. per sq.in. for five hours and twelve treatments in water at 150 lb. per sq.in. pressure (366 deg. F.) for 24 hours. The specimens were dried at 230 deg. F. for about seventeen hours between each test. The three poor aggregates showed a very slight amount of disintegration. The time required, however, was too long for the test to be useful in specifications. Samples of the aggregates were submitted to twenty cycles of boiling in water for five hours, followed by seventeen hours of drying at 230 deg. F. The unsatisfactory specimens showed about the same amount of disintegration as with the autoclave tests. This test was also too slow for use as a specification test. Grinding the aggregates and using them in 1:1 cement-sand mortar pats, which were subjected to steam at 880 lb. per sq.in. pressure for 24 hours, caused no disintegration. The results of the tests indicate that the autoclave test, in which the pressures are built up and released slowly, does not offer much promise of being a satisfactory one for including in specifications for aggregates.

Western Engineering Problems Discussed by Civil Engineers

Meeting in Yellowstone Park for its annual convention, the American Society of Civil Engineers considered problems of engineers in the National Park Service, development of the Columbia River and problems of dam and bridge design

MATTERS of special interest to engineers of the West made up the principal part of the program of the 62d annual convention of the American Society of Civil Engineers, held in Yellowstone National Park, July 6-9. After a three-day period of sight-seeing, which comprised the pre-convention activities of a number of those attending, the convention, numbering about 250, assembled on Wednesday at the Old Faithful Inn for the opening session, at which it was welcomed by Elwood Mead, commissioner, Bureau of Reclamation, representing the Secretary of the Interior, and by Clarence T. Johnston, representing the governor of Wyoming. Herbert S. Crocker, president, responded to the addresses of welcome and then delivered his annual address, taking as his subject "Some Reflections Regarding Engineering Practice." Colonel Crocker took this subject, he said, because the present is a time when most engineers are not overburdened with work and have an opportunity to give thought to both present-day problems and to the future of the profession. Colonel Crocker's remarks are important and significant and will be presented substantially in full in next week's issue.

Board of direction meeting

At the meeting of the board of direction on July 4 and 5 several matters of broad general interest were acted upon. The model law for registration of professional engineers, first drafted by a society committee in 1929 and revised early this year, was approved and adopted. It is now planned to secure its adoption by as many other interested societies as possible. The Engineers Council for Professional Development is the proposed name of a joint organization of the principal engineering societies, formed to sponsor and develop a system whereby the progress of the young engineer, either with or without college training, may be guided into and helped along the right channels of growth. The board committed the society to support this movement, which has already been approved by several other leading societies. A broader interpretation of qualifications of candidates for admission and transfer in the society was adopted, greater value now being placed on practical engineering work performed by non-graduates during their vacations or as part of their college course and on the engineering work performed by post-graduate students.

Freeman traveling scholarships were awarded to Herbert H. Wheaton (University of California), and to Donald P. Barnes (Missouri School of Mines). The Horatio Allen scholarship at Columbia University was awarded to J. Gordon Lippincott, graduate of Swarthmore College in 1931. A new section of the society to be known as the Indiana section was approved, as were student chapters at Louisiana State and Rhode Island State colleges.

Parks and streamflow

Two papers of general technical interest concerned the national parks and the effects of forests on streamflow.

Improvement of the national parks was the subject of a paper by Frank A. Kittredge, chief engineer, National Park Service, in which he outlined the work of the engineers in the park service in providing roads, water-supply systems and sewage-disposal plants with a minimum of changes in the natural conditions found in the parks. Last year there was completed in the Yosemite Park an activated-sludge plant of a capacity of 1,224,000 gal. per day to take care of a valley population of 50,000 people. In the Mesa Verde National Park, where it is necessary to depend entirely upon rainwater, the park service has constructed two acres of metal-roofed catchment area and reinforced-concrete reservoirs of a total capacity of 700,000 gal. As this has proved inadequate, the service is now drilling for water, has gone 3,500 ft. and hopes to find water at approximately 4,200 ft. In the Hot Springs National Park the mineral waters are collected and pumped to two reinforced-concrete reservoirs of 400,000 and 100,000 gal. capacity from which they are fed to the hotels and baths. All pipes and the reservoirs are insulated to conserve the heat in the water. Mr. Kittredge also described the work of the engineers of the Park Service in constructing an elevator shaft into the Carlsbad Cavern (*ENR*, June 9, 1932, p. 821) and lighting the cavern.

Walter L. Huber, consulting engineer, San Francisco, in discussing the paper pointed out the peculiar attributes of the true national parks, which are by no means playgrounds for the masses. "The inclusion of indiscriminate areas of mediocre scenic or scientific value within our system of national parks would be certain in the long run to undermine and destroy the whole system." He then pointed out that the engineer concerned with work of the national parks must become park-minded or he may do lasting damage.

The effect of forests upon streamflow was discussed by W. G. Hoyt, principal hydraulic engineer, and H. C. Troxell, associate hydraulic engineer, U. S. Geological Survey, in a paper presenting an analysis of results obtained in a study carried on in Wagon-wheel Gap in Colorado by the U. S. Forest Service and the Weather Bureau; also a comparison of those results with results obtained in southern California, where a forest fire completely denuded the valley of a stream where runoff records had been kept carefully for several years before the fire. The conclusions to be drawn were:

1. Forests do not conserve the water supply of a watershed because after their removal in the areas under study there was an increase in average annual yield amounting to 15 per cent in the Colorado area and 29 per cent in the coastal mountain area of southern California.

2. Increase in runoff is not confined wholly to flood periods. In both the Wagonwheel Gap area and the southern California area, 52 per cent of the increase occurred during the non-flood period, due to subsurface storage. This increase results either from (*a*) increased subsurface flow and storage; or (*b*) decreased transpiration; or (*c*) a combination of both.

3. The removal of vegetative covering increases normal flood heights. The belief that forest or vegetative coverage will increase summer runoff and shorten the low-water period, through the exercise of storage functions, is a fallacy in so far as the two areas studied were concerned. Coincident with the increase in summer runoff, there is an increase in the average summer minimum, and the period of low-water runoff is considerably shortened.

As a result of these findings, the authors of the paper point out that if further study indicates that the conclusions are generally applicable, hydraulic engineers and the water users must weigh such protective influence as forest cover may have in lowering normal flood crests and in preventing or retarding erosion against the detrimental effect of decreased yield and reduced low-water flow during the critical growing period. Also, in regions where shortages in water supply are becoming critical, or where abnormal expenditures have been made to augment water supplies, the maintenance of forest cover or reforestation for the "conservation of water supply" may have an effect exactly opposite to that desired. Inter-

ested discussion developed from the paper, with considerable difference of opinion apparent as to the effect of forest cover. C. G. Bates, of the U. S. Forest Service, strongly opposed any attempt to make general application of the authors' conclusions, though he conceded the probability that a bare area may yield a larger total amount of water than the same area covered with forest. He emphasized, however, the equalizing effect of the forest cover and its water-storage capacity, both of which, however, vary with the region. In general, he holds, forests increase the summer flow, and this is particularly true in the humid regions where normal forest develops. C. A. Forsling presented similar argument and pointed out the agreement between the authors and forest authorities on two points, the increase of normal flood heights and the acceleration of erosion when vegetation is removed.

Prof. Daniel W. Mead warned against drawing hasty conclusions from data based on limited drainage areas; many factors enter the problem, and unless all are known it is easily possible to reach erroneous conclusions. Certain specific areas which he cited, in Wisconsin and elsewhere, showed deforestation to have no appreciable effect on streamflow.

Roads and bridges

Three papers on bridges and one on roads comprised the program of the joint meeting of the highway and structural divisions. Steel pile foundations, timber bridges and short-span reinforced-concrete bridges were given special attention. Methods employed in the construction of roads in the national parks were described by L. I. Hewes, deputy chief engineer, U. S. Bureau of Public Roads. The national park road system as now laid out totals 1,800 miles, about one-third of which has been completed at a cost of $25,000,000. These roads serve, first, as roads that enter the parks as continuations of the federal-aid or state systems, second as roads for park traffic, usually located at highly scenic positions, and, third, as roads that are primarily intra-park roads for development of recreational values of the parks.

Most of the park roads are built in extremely rugged terrain, and thus much of the construction is of heavy mountain type as exemplified by articles recently published on the roads in the Shenandoah and Big Smoky Mountain National Parks (*ENR*, July 7, 1932, p. 10, and in this issue on p. 45).

Some notable tunnels have been built. Among them is the Wawona tunnel in the Yosemite National Park, with a length of 4,320 ft., an over-all width of 28 ft. and a height at the crown of 18 ft. The tunnel is paved with concrete, and has a 4-ft. sidewalk on one side. Ventilation is to be provided through three horizontal adits with ventilating fans at the middle adit. Ventilation is to be controlled by automatic carbon-monoxide detectors.

Steel Piles for Highway Bridges—The use of steel piles for foundations of highway bridges in Nebraska was discused by J. G. Mason and Alfred L. Ogle, bridge engineer and first assistant bridge engineer of Nebraska. The history of the use of steel piles in the state goes back 30 to 35 years.

The geology of Nebraska is such that rock is only found at great depths, and as a consequence bridge foundations have to be deep to be stable and below scour. Steel piles of 8-in. H-sections were found to lend themselves admirably to the heavy driving required for such deep foundations. Generally, they were driven in single rows for bents and were incased in concrete to a depth from 2 to 4 ft. below low water to protect them from corrosion and from floating debris. Experience has shown that little, if any, deterioration takes place below a point 18 in. below groundwater level. In many of the old county bridges where steel piles were used, no concrete protection was provided, corrosion being checked simply by red-lead paint. Examination of a great many of these piles shows a decreased section of not more than 1 per cent in twenty years.

The general principle used in the application of steel piles to such bents is to provide a clearance of 3 ft. between high water and the under side of the bridge steel, 20-ft. depth of flood water and a penetration of 25 to 30 ft. into the riverbed. When incased in concrete the wall is from 16 to 18 in. thick and extends from the bridge seat to an elevation of 3 to 4 ft. below low water. If unincased, the tops of the pile bents must be heavily braced with structural-steel channels from the top down to just above the low-water line.

The driving generally is hard and frequently results in battering the tops of the piles to a depth up to 16 in. The remainder of the pile, however, is uninjured, and the top can be cut off with gas torches in a few minutes.

William Grant, Lincoln, Neb., contributed test data from a number of foundations under overload or uplift, showing actual capacities that gave a safety factor as compared with the safe load under the *Engineering News* formula of 3 to 10 for load and 1.3 to more than 4 for pulling. He emphasized the resistance of steel piles to damage in driving but pointed out that the flexibility of the piles must be kept in mind, especially in abutment foundations under heavy lateral pressure.

M. S. Farwell, San Francisco, gave further data supporting the findings of the authors but stated that a low hammer drop must be used to prevent damage from overdriving, although the risk is less than with other types of pile. He referred to the driving of steel pipes through sandstone in Texas (*ENR*, July 17, 1930, p. 89) and to overdriving in a California bridge, (*ENR*, March 31, 1932, p. 463). He held that tests of steel piles fairly will check the *Engineering News* formula but that double the formula values may be used, as a lower factor of safety is permissible. To prevent crippling, he recommended that webs and flanges of 8-in. piles should have $\frac{7}{16}$-in. minimum thickness. As to corrosion, he held that a life of more than 25 years may be expected, provided the exposed length is well painted or incased.

A. J. Meehan, Sacramento, detailed California highway department experiences with steel piles and recommended that such piles should have a minimum size of 10 in. with $\frac{1}{8}$-in. metal, should be driven with a steel driving head fitting the pile and guided in the leads and should have no projections attached to increase the bearing capacity. John A. Crook, Denver, cited cases of a superior flood-erosion resistance of steel pile foundations over those of timber piles.

Concrete Bridges—A paper on short-span reinforced-concrete bridges, by J. W. Beretta, consulting engineer, San Antonio, presented examples of notable rigid-frame and continuous structures recently built in Texas. The Martinez St. bridge at San Antonio (*ENR*, June 25, 1931, p. 1048), with a 101½-ft. span, is the longest rigid frame in this country. The bridge is of ribbed type, the floor slab being utilized to secure T-beam action in the area of positive moments, while a soffit slab, forming an inverted T, is used to resist negative moments near the ends of the span. Cantilever footings are a feature. The Garden St. bridge at New Braunfels is believed to be the first three-span rigid-frame bridge built. Both of these bridges were designed by Mr. Beretta's organization.

The city bridge department of Houston, under J. G. McKenzie, has built four important bridges, the most notable of which is the McKee St. continuous-girder bridge described on p. 36 of this issue. The two-span rigid-frame undercrossing of barrel type at 75th St., designed for Cooper's E-65 loading plus 100 per cent impact, is believed to be the largest-capacity rigid-frame bridge yet built. A three-span rigid-frame bridge (40-, 60- and 40-ft. spans) has been completed at Alameda St. The fourth bridge, at a bayou crossing on 75th St., is of an interesting haunched-slab type, continuous over five spans (22½, 50, 60, 50 and 22½ ft.). The thickened or haunched slab acts as a cross-girder at the piers. Slender oblong piers, rigidly connected to the slab, are used at the intermediate supports, while the end piers are designed as rockers to assist in taking care of expansion, which is largely supplied by making the end spans free to move on the abutments.

In Austin two 39-ft.-span, rigid-frame bridges of rib type have been built at 32d and 34th Sts. In concluding his paper Mr. Beretta expressed a hope that more federal and state bridge work be

turned over to consulting engineering firms, in the interest of fostering designs more economical than the standardized ones often used, and with the result that employment of engineers be substantially improved. Under such a system the function of governmental bodies would be to act in advisory and coordinating capacities only.

In discussion Leslie G. Holleran, Westchester County Park Commission, reviewed the history of the adoption of rigid-frame construction in the Westchester parkways, where 84 of the structures have been built since 1922. He gave credit to Arthur G. Hayden for developing rigid-frame construction in application to bridges.

Timber Bridges — With the double purpose of increasing the use of a local product—Douglas fir—and of meeting the needs for drastic economy in public works, the Oregon state highway department in cooperation with lumber interests has been investigating the subject of timber bridges. C. B. McCullough, bridge engineer of the state, presented the results of the investigation. Some type of preservative treatment is necessary to combat decay. All material should be prefabricated and preframed before treatment. A structural timber specification supplemented by a careful system of inspection will do much to eliminate poor and nonuniform materials. Fire hazard may be reduced by utilizing a concrete deck, and this type of construction also reduces maintenance costs. Mr. McCullough presented a specification for structural Douglas fir, as well as several standard designs that have been adopted by the Oregon highway department. A careful attempt is being made to develop the new bridges architecturally as well as structurally.

One of the difficulties in using a concrete deck on timber stringers, as contemplated in one of the standard designs, arises from the relatively extreme stringer deflection. Studies at Oregon State College are now under way to develop a shear connection between the concrete deck and the stringers, so that the concrete will act as the flange of a composite T-beam. Daps in the stringers, protruding spikes and combinations of the two are being tried as possible shear connections. The details will also be tested for temperature effect, since there is a dangerous difference in the thermal coefficients of the two materials.

Z. E. Sevison, Wyoming highway department, stated in discussion that Wyoming has built prefabricated timber bridges for some years. He estimated that some 2½ million dollars has been saved during the last few years by using this construction for short-span permanent highway bridges. The department has standardized on laminated floor construction covered with 2-in. bituminous gravel surface and does not consider concrete floors suitable.

Milo S. Ketchum, University of Illinois, and S. H. Cook, Denver, also said that laminated timber floors are the best for this type of bridge. Experimental study of laminated floors is now in progress at the University of Illinois. In Nebraska, according to J. G. Mason, highway bridge engineer, concrete decks have been used as well as laminated decks because of the local availability of concrete materials.

Columbia River development

A review of the Columbia River study recently made by army engineers was presented to the meeting of the combined irrigation and power divisions by Col. Thomas M. Robins, division engineer, Pacific division, San Francisco, Calif. The army engineers divided their study into four main heads—navigation, flood control, power development and irrigation—studying each in its relation to the other to see how best they could be integrated for complete development of the river. On the subject of navigation Colonel Robins referred to the fact that between Portland and the sea a ship channel 500 ft. wide and 35 ft. deep had been practically completed, that canals and locks afford a depth of 8 ft. up to Celilo Falls, that from there up to the mouth of the Snake River obstructions have been removed from the channel, and that for 240 miles above the mouth of the Snake open river channel work had been prosecuted to obtain a depth from 5 to 7 ft. Above the Snake River conditions are not favorable to the future development of any considerable amount of water-going commerce, and even though the river were fully improved the resultant savings would be small.

In the non-tidal section below the Snake River, where there exists a large and relatively extensive rail movement of freight parallel to the river in and out of the tributary area, Colonel Robins states that conditions are quite different. There a large percentage of outbound freight is wheat, and inbound freight is petroleum products, which could be moved by water at a considerable saving, estimated at about $1,000,000 a year. Combining the navigation improvements of this section with power developments would make an amount of $16,100,000 chargeable to navigation.

Flood control is not an important element of the problem. The Columbia River and its tributaries afford unusual opportunities for the development of great quantities of power, according to the study of the army engineers. Ten suitable sites exist along the international boundary, and one (that at Rock Island) has been developed recently. With regulations from 14,000,000 acre-ft. of storage in the upper Columbia and its tributaries, and 12,000,000 acre-ft. in the Snake River basin and the tributaries of the lower Columbia, after making due allowance for future irrigation requirements, the firm-power capacity of the ten projects would be about 5,212,000 kw. and the installed capacity about 9,655,000 kw.

Certain disadvantages, however, were noted as standing in the way of developing these sites. Colonel Robins said that the great expenditure and the large blocks of power involved in developing the sites, particularly the large ones, makes any one of the projects unattractive to power companies, unless federal financing is authorized, because the companies can, for many years to come, develop the projects on tributary streams that will furnish power in blocks more suitable to their market requirements. A general view of this situation is obtained, he stated, if we keep in mind that the hydro projects placed in operation in this market area since 1930, together with those for which plans are well developed, will provide twice the amount of electric power that has been installed in this area from 1920 to 1930.

Colonel Robins stated that 4,000,000 acres of land in the Columbia watershed are under irrigation, and that about 2,000,000 acres remain, most of which is in the so-called Columbia Basin irrigation project. After reviewing the estimated costs of the several proposals for irrigating the Columbia Basin, he stated that as a business proposition irrigation of the land is not feasible at this time, nor does it appear to be justified.

Dams and uplift

Discussing Colonel Robins' paper, H. A. Rands, Portland, expressed himself in favor of development of the Dalles power site, claiming advantage for it because of ocean transportation; he argued specifically for development of the port of Portland. Import of raw materials for electro-chemical industries and export of wheat were pictured as the major navigation possibilities, the industries to be users of the power. Aluminum and ferro-alloys could absorb all the power of the Dalles plant. Mr. Rands also presented an outline of a construction method for the project.

John C. Stevens, Portland, urged that small developments that would interfere with prosecution of the general development plan of the Columbia should not be permitted. L. Yager, St. Paul, directed attention to the importance of marketing, both of agricultural and industrial products, and to the effect of steam-power economies on great hydro projects. He questioned the wisdom of making the development of the Columbia a national project and of subsidizing water transportation of wheat. C. I. Grimm, San Francisco, replied that in the Columbia Basin hydro power is cheaper than steam power, in view of the cost of fuel. William Grant, Lincoln, referred to the competition of irrigation development with Mississippi Valley agriculture and argued against any extension of agricultural areas.

E. B. Debler, Denver, reviewed the decline of mining and lumber in the

Northwest and stated that future growth of the region depends upon additional production, principally in agriculture. Hence, he argued, it is not a question of whether the Columbia Basin project would be a paying proposition; the project may be desirable as a means of increasing the economic stability of the Northwest and assuring its further development.

Measurements of uplift under ten dams were summarized by Ivan E. Houk, senior engineer, U. S. Bureau of Reclamation, in a paper prepared at the request of the special committee on irrigation hydraulics as part of its research on the subject of pressure under dams. The dams upon which measurements have been made are as follows: Oester and Neye in Germany, Willwood in Wyoming, Medina in Texas, Brule River in Wisconsin, Pit River No. 3 in California, American Falls in Idaho, Bull Run in Oregon, Gibson in Montana, and Ariel in Washington. The Willwood, Medina, Brule River and American Falls dams are straight gravity structures having maximum heights of 70, 166, 70 and 80 ft. respectively. The Oester, Neye, Pit River No. 3 and Bull Run dams are curved gravity structures having a maximum height of 131, 100, 122 and 200 ft. respectively. The Gibson and Ariel dams are arched structures having maximum heights of 200 and 313 ft. respectively. All foundations were grouted except at the Brule River and Oester dams, and all foundations were drained except at Oester, Neye and Willwood. Drains were installed under the apron at the Willwood dam but not under the main portion of the structure. Pipes for making uplift-pressure measurements have been installed in the foundation level and at various horizontal joints in the Owyhee dam, a 405-ft. curved gravity dam now nearing completion, and plans are being made for similar installations in Madden dam, now under construction in the Panama Canal Zone.

Mr. Houk stated that thus far experimental investigations, either in the laboratory or at existing dams, have supplied no satisfactory answer to the question as to the proportion of the horizontal cross-section area upon which uplift pressure acts. Valuable data have been secured in the case of porous materials, but no adequate information has been secured in the case of horizontal construction joints within the concrete, or in the case of contact areas between the base of the dam and the actual rock foundation.

By a diagram Mr. Houk illustrated the results obtained at the ten dams tested. In studying the results of the uplift pressures obtained, Mr. Houk stated that it must be remembered that no data are available regarding areas on which the observed pressures act. All that is known is that the observed pressures cannot act on more than 100 per cent of the base area. This appreciable proportion of the concrete area must be in direct contact with the foundation rock. At most existing dams the effective areas acted upon by uplift forces are doubtless considerably less than 100 per cent. As only maximum observed pressures were used in the preparation of the uplift diagram, Mr. Houk stated that it is evident that the design assumptions were adequate in the case of the American Falls, Willwood, Gibson, Bull Run and Ariel dams, the only ones for which data on design assumptions are available. He also noted that at Bull Run and Ariel dams, where the assumed uplift conditions were least severe, the bases of the dam are more nearly free from uplift pressure than are the bases of any of the other dams represented.

Leaving out of consideration the Oester dam in Germany, where the foundation rock was not ideal and where, apparently, modern precautions of grouting and draining the foundations were not taken, Mr. Houk states that it will be noticed that the observed pressure curves are fairly well grouped between the base of the dam and a line representing a pressure range from two-thirds of the full pressure at the heel to zero at the toe. Therefore he believes that for purposes of design, assuming satisfactory foundation rock and adequate grouting and drainage operations, an uplift-pressure area ranging from 100 per cent at the heel to zero at the toe of the dam is a conservative assumption.

From uplift-pressure measurements at horizontal construction joints made at Gibson dam under heads as high as 112 ft. and at distances from the upstream face of the dam as small as 6 ft., and from measurements made at Ariel dam and at Bull Run dam, it seems safe to conclude that uplift-pressure assumptions applicable to the foundation level will be more than ample for horizontal construction joints.

D. C. Henny, Portland, Ore., presented an extended analysis of uplift and its effect on the stability of gravity dams. From experiments on pore pressure by S. H. Woodard he concluded that internal pressure occurs in dam concrete through pore effect, estimating the pressure area at not more than 12 per cent of total area. For uplift at the foundation he suggested a pressure area of 25 per cent where the vertical loading equals the water pressure, the same proportion of area to be used with diminishing uplift pressure to the toe. In the calculation of so-called sliding resistance he proposed to include the shearing strength of the concrete as part of the resistance, acting in conjunction with the friction that would be developed by sliding under a load equal to the weight of the concrete less the uplift. The sum of this resistance divided by the horizontal force would give the factor of safety against sliding. He therefore argued the importance of developing high shearing strength. Mr. Henny challenged the Lévy requirement for masonry weight at water face equal to or greater than the water head and said that the requirement is excessive.

John H. Gregory, Baltimore, expressed doubt as to the sufficiency of knowledge about uplift and emphasized the uncertainties of foundation exploration and knowledge of jointing as well as the chance of derangement of drain systems. C. E. Pearce, Pasadena, held that 50 per cent uplift near the upstream face should be sufficient, and that it is questionable whether shear and sliding friction work simultaneously. Some existing dams should fail if the Henny analysis holds true.

Tests for Hydraulic-Fill Dams—In a long and carefully worked-out paper, H. H. Hatch, engineer in charge of the Cobble Mountain dam at Westfield, Mass., discussed the various methods used in testing materials going into hydraulic-fill dams and presented derivations of the formulas used in the work at Cobble Mountain. Mr. Hatch's paper was a plea for standardization of methods used in testing earth for such dams. Differences existing in methods now employed were discussed in detail.

In discussing the paper D. C. Henny, Portland, emphasized the importance of colloids in earth dams in relation to moisture-holding capacity and the cause of failure. George W. Fuller, New York, pointed out, however, that Mr. Hatch had emphasized the need of further study of material passing the 200 sieve; this would include the particles that exhibit colloidal character. A cooperative investigation to study these materials was suggested.

Duty of Water—In a paper on duty of water in terms of canal capacity, E. B. Debler, Bureau of Reclamation, Denver, argued the reasons that led early irrigators and legislators to adopt excessive duty areas in irrigation. "The proper canal capacity is not a simple problem of dividing the project area by a figure of 70 or 80 as state laws would appear to imply," said Mr. Debler. Actual plant use accounts for only a third of the water consumption on most projects. Seepage from canals and laterals is the principal waste, amounting to half the total, the remainder including evaporation, percolation and operating wastes. Because of the influence of type of crop and culture method, canal capacities on northern projects with short seasons are relatively greater than those on southern projects. He discussed other factors of duty and invited the contribution of data to a committee of the irrigation division. Some experiences were contributed in discussion by Sam G. Porter, of Calgary, G. E. P. Smith, of Tucson, and Harold Conklin, Sacramento. Mr. Porter described canal obstruction by plant growths on the Bow River project in Canada and the effective use of chain dragging to clear the canals, the chains weighing 15 to 19 lb. per foot.

American Sewage Treatment As Seen by an English Expert

Impressions of John D. Watson, following an extended trip through Eastern and Middle West plants

"IN VISITING American sewage plants again after an interval of eighteen years, I have been tremendously impressed with the progress that has been made in solving the sewage problems of your great cities," said John D. Watson, consulting engineer, of London, England, recently to a representative of *Engineering News-Record*. Mr. Watson had just completed a tour of inspection of American sewage plants that included those at Baltimore, Yonkers, Indianapolis, Milwaukee and Chicago, and those under construction at New York and Cleveland. "I have also been gratified to note the greater appreciation on the part of American cities of the need for sewage treatment," he added.

Contrasts between American and English conditions received Mr. Watson's particular attention. "I never fail to be impressed by the enormous quantities of sewage it is necessary for you to provide for. You will understand what we in England think of the treatment methods that you are favoring in America when I tell you that the new plant for Middlesex County in England will incorporate design features similar to those exhibited by a typical activated-sludge plant in the United States. The activated-sludge process, or, as we call it, bio-aeration, is as highly favored abroad as it is here. In both places I have noticed that trickling-filter treatment is still an accepted process, but that contact beds are no longer built to any extent.

"I have seen a number of splendidly operated plants within the past few weeks. Baltimore presents an excellent example of the type of plant that uses separate sludge digestion with trickling filters for secondary treatment. The experiments now being conducted there on mechanical dewatering of sludge and sludge digestion are well considered.

"Spiral-flow aeration tanks, such as I saw in Indianapolis, are now almost universally used. At that plant at Indianapolis advantage is quite properly taken of periods of high river flow to reduce the degree of treatment provided, thereby decreasing the cost of operation.

"There is an instructive example of screenings incineration at South Yonkers, N. Y. At that plant, located in a high-class residential district, the coarse and fine screenings from the sewage of 200,000 people are burned without causing a bit of odor nuisance. It appears to me to be a satisfactory method for the disposal of screenings, provided there is a competent and dependable personnel. They will have to be careful to feed the material at the proper rate.

"At North Toronto there is a plant of the activated-sludge type, providing separate digestion for mixed and fresh activated sludge. Some difficulties have been encountered in drying the mixed sludge, due to its high moisture content, but by and large it is an excellent example of modern high-grade practice.

"Cleveland's Easterly plant, now under construction on the lakefront, has behind its design the experiences gained in the operation of numerous similar plants, so that it can be considered typical of a modern standard plant of the activated-sludge type. As at the Chicago North Side plant and at the plant now being designed for Middlesex County, sludge may be pumped out of the suburban residential area where the plant is located to be disposed of elsewhere."

Chicago has bettered recommendations of 1914

Mr. Watson last visited Chicago eighteen years ago. At that time he helped formulate the Watson-Martin-Soper report on the Sanitary District of Chicago, made for the Chicago real estate board. The report included requirements for the cleansing of the Chicago River, considered drastic at the time but surpassed by recent accomplishments. Today the sewage from more than half the population is being treated, much of it to the point where the effluent is stable and the sludge is inert. Mr. Watson recalled that in 1914 there were 3,000,000 people living within the Sanitary District discharging sewage into the drainage canal without any treatment.

In their study of the situation Mr. Watson and his colleagues reported that they had traced the pollution due to Chicago sewage as far down the Illinois River as Peoria. They regarded the elimination of organic solids essential if the purity of the river was to be maintained. Mr. Watson expressed his admiration for an administration which took so far-sighted a view of the subject as to surpass the recommendation, and to proceed to erect the largest purification plant in the world.

"New York," said Mr. Watson, "has apparently been slower to realize its obligation to its vast population, but it has been my privilege to inspect the sewage works now under construction on Wards Island, which, when completed, will compare well with those at Chicago.

"Let me illustrate one of the extraordinary developments that have come about within the past twenty years. When Dr. George A. Soper, chairman of the Metropolitan Sewage Commission of New York, consulted me about the advisability of purifying New York sewage by oxidizing it on percolating filters located on Wards Island, I emphatically condemned the proposal. If I had been asked that question only two years earlier, my answer would have been different. My change in view was caused by the unusual experience of Birmingham and other English cities during a two months' drought in 1911. During that time the trickling filters were responsible for serious odor nuisances. Evaporation during the day was high, resulting in a vaporous cloud of sewage hovering above the plant. During the early hours of the following morning this cloud settled back to earth, but sometimes it drifted as far as 4 miles away, causing seriously offensive conditions.

Close-in plants now possible

"The development of the activated-sludge process, which came after the final report of the Metropolitan Sewage Commission of New York, rendered it possible to use Wards Island as a site for a sewage plant. To handle the sewage of such an enormous population almost under the nose of the greatest city in America indicates, in my opinion, the progress that science has made toward the ultimate solution of the sewage-treatment problem. Only a few years ago it would have been foolhardy for any engineer to propose treating the city's wastes so close to such a vast concentration of population."

Three years ago Mr. Watson reported to the County Council of Middlesex on the best way of disposing of the sewage of 22 satellite towns that adjoin the west and northwest of London. In his report he cited the Sanitary District of Chicago as an example of coordinated effort by a number of communities for the treatment of sewage. At that time the Birmingham, Tame and Rea District drainage board was the largest board of its kind in England. Mr. Watson's recommendation for the participation by the various communities was received with favor, but before the scheme could be adopted the government in 1930 passed an act of Parliament empowering county councils (on the petition of local authorities) to undertake schemes of this kind. The Middlesex County Council unhesitatingly accepted an invitation on the part of the 22 urban district councils and applied to Parliament last year to acquire land and easements for sewers and sewage plants. The estimated cost of the program of construction is $30,000,000. Contracts have already been let under the supervision of Dodd & Watson, consulting engineers, instructed by the County Council of Middlesex. Ten of the contracts have been let and others

are at present in the course of being prepared.

One of the factors lending support to this scheme was the enormous migration of population from London to adjacent areas. Thirty existing sewerage systems discharge their effluents into three small rivers, one of which is utilized to supplement the water supply of London. Apart from this the small towns were much concerned about their rapid growth, obliged as they are to maintain the purity of the rivers.

The new scheme provides that all sewage effluents are to be purified and discharged into the tidal water of the Thames. Sewers will serve an ultimate population of 2,000,000, and the purification works to be constructed immediately will serve a present population of 1,000,000. The sewers will be designed to carry six times the dry-weather flow (40 Imp. gal. per capita). One-half of the maximum volume will be given complete treatment, and the other half, largely stormwater, will be partly treated. The treatment plant will be designed along lines similar to those adopted at Chicago and New York. It will comprise sedimentation in tanks and aeration by diffused air applied through porous plates. The sludge, both activated and crude, will be pumped to an area 7 miles away.

Mr. Watson commented favorably upon the progress made in America in regard to the digestion and drying of sludge. "In England," he said, "sludge has been sold as a fertilizer for many years. It is to be hoped that this phase of the question will improve as experience accumulates, but I am not so sanguine as some of my friends are that municipalities will make a profit out of the sale of sludge, or that farmers will gain materially by its use. For sewage sludge to be of benefit to farmers the cost of transportation must be low, and the soil to which it is applied must be of a suitable nature.

"The dewatering and incineration of sludge sounds very attractive, particularly for large-scale operation like that in Chicago, where it is necessary to dispose of more than 600 tons of dry solids per day. However, it will be necessary to give a great deal of study to the cost involved. The new 20-ton plant at the West Side works should provide a valuable demonstration of the feasibility of this procedure. Sludge incineration has been tried a few times in England, mostly when mixed with house refuse.

"Perhaps one of the most praiseworthy things in the field of sanitary engineering is the whole-hearted cooperation and willingness to share experiences shown by those engaged upon sewage problems the world over. Nowhere does anything seem to be withheld. Information is freely exchanged in both Europe and America. That give-and-take policy is something in which the sewage-works personnel may well feel satisfaction."

Construction During the First Half of 1932

ESTIMATES based on contract award figures of the first six months of the year indicate that construction of all classes for 1932 will reach a total of 2.8 billion dollars, compared with an estimated total of six billions for 1931 and 9.3 billions for the average of the six years, 1925 to 1930. Of this amount 1,744 millions will be for public works, represented by 344 millions for federal and 1,400 millions for state and municipal work. Private construction is expected to reach a total of 1,072 millions for 1932, 686 millions going for private engineering construction and 295 millions for residential work. These figures agree closely with previous estimates based on construction during the first quarter of the year.

The cumulative total for all classes for the first half of the year represents 41 per cent of that for the similar period of last year, and 30 per cent of the 1925-30 average.

Fig. 1—Volume of private, public and total construction for eight years, with 1932 estimated from first six-month figures.

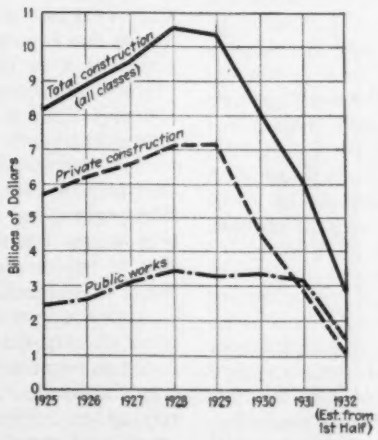
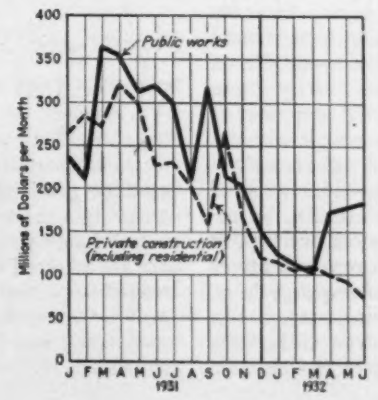


Fig. 2—Private and public monthly contract awards, showing how public construction has been gaining over private during past few months.


Millions of Dollars per Month
Public works
Private construction (including residential)
J F M A M J J A S O N D J F M A M J
1931
1932

All of the values stated and those plotted in the accompanying curves represent estimated total construction for the entire country. The construction figures published weekly and monthly in *Engineering News-Record* are those reported for certain classes of work and exclude contracts below specified minimum limits, and are therefore lower in volume than those given herein.

Outlook for Second Half of Year—On the basis of the steady horizontal trend maintained during the spring months in the record of contract awards, the prospect appears good that the second half of the year will see an average maintaining the monthly figures recorded so far this year. This is the basis for the forecast of 2.8 billion dollars given at the opening of this article.

CONSTRUCTION CONTRACTS DURING 1932

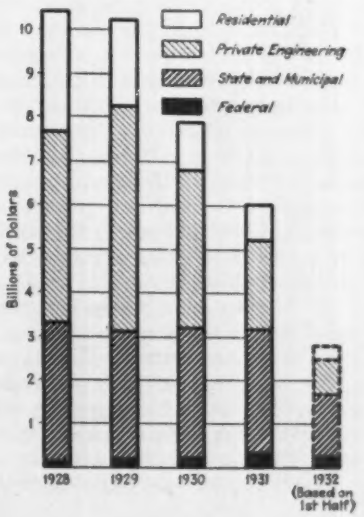
Ratio of 1932 construction to 1931 and 1925-30, cumulative for first half of each year

(Millions of dollars)

	Federal	State and Mun.	Private Engineering	Residential	Grand Total
Average 1925-30	$119	$1,590	$2,080	$1,259	$4,817
1931	231	1,530	1,202	491	3,454
1932	169	675	412	163	1,419
Ratio of '32 to '25-30, per cent	142	50	20	13	30
Ratio of '32 to 1931, per cent	73	44	34	33	41

A definite increase over this figure may, however, be realized as the result of the aid to construction that is expected from the pending relief bill. Any revival of business activity, moreover, will be quite likely to bring additional industrial and residential construction into the market, which will further help to raise the second half-year's average.

Fig. 3—Ratio of private engineering, residential, state, municipal and federal construction to total for past four years, with 1932 estimated.



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JULY 14, 1932 Volume 109 Number 2

A Six Months' Record

WHAT has happened to construction during the first half of the current year is well known. The figures, brought togther in graphical form in this issue, make the situation concrete. They show a rate of activity about one-third of normal and less than half the reduced volume of 1931. Since the data are dollars of expenditure, the lowering of cost that has taken place makes the comparison somewhat more unfavorable than it should be; but even allowing for cost changes, the picture is discouraging enough. That private construction, both engineering and residential, is at an abnormally low level is not surprising in view of the momentary excess of supply over demand and the tightness of industrial and business credit, but the sharp decrease in public construction is a matter of much greater concern. Even with fully maintained rate of construction, public services lag behind normal requirements—in water, sewerage, streets and institutions alike. The present shrinkage seriously increases the arrearage. However, the record has one encouraging feature, in that the curve of activity has remained fairly level, holding well against the usual summer drop. This steadiness reflects a tendency toward resumption of public work that may bring the year's total well above the low figure now forecast. Such resumption will react on private industry as a stimulant and will help to bring business and employment back to normal.

Making It Costly

ONE OF the contributory causes of the curtailment of public construction shown by this year's record is the popular chorus of denunciation of governments that has been sounding for many months, a phenomenon without precedent in our history. Much of this denunciation originated with real estate men, who apparently hoped thereby to force a reduction of taxes large enough to help them carry their overload of debt charges through the period of deflation. But denunciation may have the result of increasing rather than decreasing government costs. Clarence E. Ridley, in a passage of his article on municipal cost reduction, points out the risk in these words: "Continuation of the scoffing and sneering at government constitutes a certain way to more costly and inefficient public service." The force of the remark is too obvious to leave room for question. If municipal government is to be made efficient, it must first be accorded honor and respect. Citizen groups can accomplish more by working with their governmental representatives and servants than by opposing and denouncing them. Apparently this truth is coming to be recognized, for in recent weeks cooperation with city and state authorities has largely replaced the criticism of the preceding months. But the harm already done will be felt for some time to come in lowered efficiency and economy of governmental service.

Wise Counsel

IN HIS presidential address to the American Society of Civil Engineers Col. H. S. Crocker gave wise counsel when he spoke of the necessity of experienced field engineering to assure efficient construction. Engineering works are built in the field; the designer at his desk does only preliminary planning. This has always been true and is likely to remain true so long as men carry on contruction. Skill, experience, resourcefulness and sure technical judgment are therefore indispensable qualities in the field engineer. Inspection is an auxiliary but not the essential element of field enginering, and where the field direction is limited to inspection there is apt to be trouble, delay and inefficiency, sometimes even deficiency in the resulting structure. Colonel Crocker's advice is particularly pertinent under modern conditions, for the very thoroughness of plans and specifications increases the need for technical knowledge, ability to adapt methods to conditions, and quick judgment in the field. These qualities alone will bring about that complete cooperation of engineer and contractor upon which construction efficiency depends.

Professional Prospects

LARGE movements in technology and industry are at issue in Colonel Crocker's further comments, bearing on the future prospects of engineering practice. He forecasts a revival of private practice as the result of engineering decentralization. Looking back, one may see a steady decline of the private consultant during more than thirty years. As staff engineering departments were built up by railroads, industries, cities and states, and as they became competent and efficient, the demand for outside engineering service inevitably declined. Now question arises whether staff development and centralization of engineering work has gone too far. The breakdown of pyramided utility organizations and the failure of many industries to preserve their staff organizations from disintegration under reduced business volume raise doubt as to what degree of technical staff organization is good business. In at least some cases a smaller staff, relying on engineers in private practice for peak and specialized service, gives promise of greater efficiency; and if the same condition is found to hold more widely, the consulting engineer may return to his old-time importance.

Forests and Streamflow

MORE DATA and study are needed before the conclusions of Hoyt and Troxell, presented to the American Society of Civil Engineers on the harmful effects of forests on streamflow, can be accepted as a basis for practical application. The observers found in one or two cases that forest cover reduces the average annual water yield as well as the summer runoff. The data are affected by the special conditions of the Western areas studied, and until they are supplemented by similar data for characteristic stream basins in other climatic, topographic and geologic areas, including also the Eastern states, the conclusions cannot claim general appli-

cability. The years of inconclusive discussion about the effect of forests on floodflow reflect the intricacies of the hydrologic problems involved. And in the background is the broad fact that flashy streams are most common in regions unforested or bare but are relatively rare in regions of heavy vegetation and deep soil. The ultimate facts and conclusions will doubtless harmonize all observations; but in the meantime the present conclusions invite the attention of all hydraulic and water engineers who may have to deal with questions of forestation or change in vegetative cover.

Drastic Remedy

ABUSE by motorists of their privilege of right-of-way on non-stop arterial streets has recently led to the withdrawal by the San Francisco street authorities of several such streets from the privileged class. In trying to cut into heedless arterial traffic, cross-street traffic was compelled to take a risk that piled up accidents or else was delayed beyond all excuse. The remedy adopted by the San Francisco authorities is obviously a rather drastic one for general application, whatever may have been its local justification. The protected arterial street is a sound and in many cases indispensable traffic-control device in cities; where its privileges are abused by motorists the usual remedy is to enforce its rules more effectively rather than to abandon the system and renounce the protection that it offers.

Organic Improvements in Government

IN THIS issue there appears the second and concluding article by C. E. Ridley outlining what is necessary for cities to do if the costs of municipal activities are to be reduced. In his first article, which appeared in the issue of Juy 7, the author made specific suggestions as to what can be done immediately by almost any city to raise administrative efficiency and reduce unit costs so that essential services may continue unimpaired but at lower total cost. In the present article he gives the results of his study of the more fundamental causes of costly administration and recommends specific reforms in governmental structure to the end that efficient and economical administration will be facilitated. And this latter is much the more important in the long run.

American cities have had unhappy experience with reforms. The usual pattern for reform movements is about this: The electorate, rendered indignant at some flagrant breach of public trust or scandalous evidence of incompetence in office, supports an independent "businessman" candidate, who sincerely promises that he will give an administration containing all the efficiencies that characterize his private business affairs. Almost invariably these reformations end unsuccessfully, because they leave the basic problem untouched. High abilities and good intentions cannot administer efficiently an organization that remains obsolete and unwieldy. Sterling integrity cannot make up for the continuous drain of public funds occasioned by duplication of effort, vagueness of duty and responsibility, and lack of training of personnel. The reforms recommended by Mr. Ridley are aimed directly at these organic ailments. They are not based on the naïve belief that the mere change of an administrative head will produce efficient and economical public service. The remedies proposed go deeper than that.

It is obvious that the preparation of measures designed to reform governments is not properly a task for amateurs. Neither is it to be done in a spirit of hot-headed rebellion or political partisanship. It is a task that involves a capable study of all local conditions and must be performed by one who is interested only in creating the greatest possible advantage to the municipality. Panaceas in the form of univeral reforms are ill-advised in application to cities of the metropolitan class, for the conditions surrounding one city are not likely to be duplicated or even resembled by those of another.

The author of the present article has made a competent analysis of city conditions. His recommendations involve, among other measures, a consolidation of many of local governments, to reduce overhead. Legislation will be required to bring this about, and legislation is slow. But however slowly consolidations may be made, the tendency today is undoubtedly in that direction. The past few years have made an imposing record in transferring functions from township to county or from county to state, or in an absolute reduction in the number of such local jurisdictions. Administrative boundaries based upon the communication and transportation needs of a century or more ago are expensive luxuries in 1932.

Consolidation of departments, however, can be effected by the exercise of powers now possessed by city governments. How that power is to be exercised must also be determined in dispassionate manner, divorced as far as possible from considerations of political expediency. Fortunately, in this regard many meritorious consolidation plans have already been made by governmental efficiency organizations. In all improvements of this nature the assistance and cooperation of such agencies are highly valuable and should be utilized to the utmost.

But even the elimination of overlapping governments and departments will not go far toward improvement if lines of authority and responsibility are not more clearly defined. At present the functions of policymaking and administration are hopelessly entangled, presenting serious handicaps to effective work. Too often responsibility fails to be accompanied by the proper degree of authority, so that a passive policy is adopted for self-protection. Here improvements depend to a large degree on a public attitude that will grant a degree of authority to administrative officials commensurate with the responsibilities demanded of them.

To this end, the professionalization of public servants is essential. Public service should be a career, with continued employment and advancement based on training and ability in performance. Many branches of public service have already been placed in this status, such as the engineering and public health departments. The high standard of performance that these departments usually set is a strong recommendation for the extension of the principle.

It is to be realized that all these reform proposals will be strongly opposed in some quarters. Only the steady pressure of public opinion can put them into effect. And that, in the final analysis, means an appreciation by the public at large of what good government involves and a desire by the public to obtain it. It will have to realize that government today is an expert's task and that only by the application of the expert's technique can good government be formulated and administered. The explosive force that results from tax-reduction pressure is ill-designed to achieve the desired result.

NEWS OF THE WEEK

Chicago District Tells Supreme Court Sewage Program Lags

THE sewage treatment schedule laid down by the Supreme Court of the United States for the Sanitary District of Chicago to carry out, came to a standstill more than six months ago, according to the district's semi-annual report of progress. A financial crisis was reached last December and conditions since then have grown steadily worse.

Bonds to the amount of $43,000,000 can be sold, but no reasonable offer is obtainable for them. About 16 per cent of the 1928 taxes are still unpaid, 30 per cent of the 1929 taxes are uncollected and only 50 per cent of the 1930 taxes are paid. The 1931 taxes, ordinarily collected by May 1, 1932, have not yet been extended, so that municipalities in Cook County are two years behind in their revenues.

The Sanitary District, so the Court is told in the report, has not been able to pay current bills or contractors since Nov. 1, 1931, except in a few cases where the payee succeeded in finding purchasers of tax anticipation warrants.

The engineering organization having to do with the sewage treatment program has been reduced 64 per cent. Salaries of those remaining have been reduced and no one has been paid since April 1. Defaults in interest and principal now amount to $7,596,055.

Under the above circumstances adequate progress cannot be expected, says the report, unless financial aid can be arranged through some organization like the Reconstruction Finance Corporation. Up to the present time all efforts to finance construction ordered by the court have been unsuccessful.

The extent of the operation of sewage treatment plants at the present time is equal to 100 per cent treatment of the sewage of 1,562,000 people out of the District's total population of 4,936,000. This indicates the treatment of 31.6 per cent of the total sewage in the district.

St. Louis Considering "Made Work" Bond Issue

Men engaged in public works and unemployment relief in St. Louis are discussing a five to ten million dollar bond issue to be used in "made work" for the relief of unemployment. Should such a proposal be voted favorably it will not increase the normal sewer and paving work but will affect mainly grading, landscaping, clearing, ditching and other work with a high percentage of direct labor. Even this plan, operated on a part-time employment basis, is not expected to take more than 30 or 40 per cent of the needy families off the direct charity list.

W. W. Horner, chief engineer, sewers and paving, states that the season's work is down to 40 per cent of the program for the last few years. The paving program amounts to $2,500,000 and sewer work $1,000,000. Next year's program now under consideration is likely to show an even greater slip insofar as standard work is concerned.

Indianapolis Building Wages Increased 5 Per Cent

Wages in the building trades in Indianapolis were increased 5 per cent on July 1. The wage increase was in accordance with an agreement reached last winter with officials of the various building trade unions. At that time 20 per cent reduction in wages was put into effect with the understanding that there would be an increase on July 1. The new scale will remain in force until December, when there will be a conference at which wages will again be adjusted on the basis of the cost of materials at that time.

Amendment to Bacon-Davis Law Tabled at Request of Sponsor

Vetoed by President Hoover, the Metcalf bill that would require predetermination of wages on government contracts has been tabled by the Senate at the request of its sponsor. If he brings it up either in the closing days of this session or at the December session, the prospect is that the bill will command the necessary two-thirds vote in the Senate but that it will become embroiled in a partisan fight in the House.

In the absence of amendatory legislation to the Bacon-Davis law there is a possibility that J. R. McCarl, the Comptroller General, may intervene, but it is impossible to predict whether he could force the Department of Labor to make wage rates part of the specifications. Organized labor's attitude is that the prevailing rate is the union rate, while the contractors contend that the prevailing wage is the rate paid to the largest number in a particular locality at a given time.

Federal Relief Bill Passed and Vetoed

Provision for public works loans limited to toll and rate projects—Appropriation for federal construction included in emergency road loan

ON MONDAY, July 11, the emergency relief bill long under discussion in Congress was vetoed by the President after passing both houses in the form agreed upon in conference. The bill made little provision for financial aid to state and municipal public works, limiting aid in this direction to self-liquidating works. It included limited-dividend loans for housing and certain other financial aid to private parties.

Title I of the bill authorized the Reconstruction Finance Corporation to loan $300,000,000 to the several states and territories for relief work, the sum to be available during two years. Such loans were to be reimbursed with 3 per cent interest by annual deduction from federal aid highway grants beginning in 1935. Part of the relief loans might be paid at the request of a governor direct to a municipality or other subdivision of the state, these loans to be repaid by the borrowing municipality.

Title II amended the Reconstruction Finance Corporation Act (Sec. 5) to empower the Corporation to make loans to "any person" unable to obtain funds upon reasonable terms through banking channels. In extending such loans preference was to be given (1) to states, cities and other subdivisions or agencies to aid in financing self-liquidating projects, the loans to be made by purchase of the securities of the governmental unit concerned; (2) to housing corporations undertaking self-liquidating projects; (3) to private corporations constructing self-liquidating bridges, tunnels, docks, viaducts, waterworks, canals and markets; (4) to limited-dividend corporations developing forests or other renewable natural resources; (5) to builders of publicly owned bridges to be operated wholly or partly on tolls. Loans on agricultural products in storage or to finance export sales were also authorized, as was the establishment of regional agricultural credit corporations to make advances to farmers and stockmen.

Title III provided for emergency construction of certain authorized federal public works by direct appropriation of $322,224,000. This sum included emergency highway loans of $120,000,000, available for matching the regular federal aid apportionments, the loans to be repaid during a 10-year period beginning 1938. For forest and other federal roads, $16,000,000 was provided, for river and harbor projects $30,000,000, for flood control $15,500,000, for Hoover Dam construction $10,000,000, and other sums to various services and public works, including a long list of specific military posts. For the purpose of the bill the R.F.C. was authorized to increase its issue of securities by $1,800,000,000.

In vetoing the bill the President approved of the relief loans of Title I. While opposing the appropriation for federal public works, his essential ground for the veto however was the authority under Title II to extend R.F.C. loans to "individuals, trusts, estates, partnerships, corporations and associations, joint stock companies, states, political subdivisions of states, municipalities." This, he declared, would mean loans "for any conceivable purpose on any conceivable security to anybody who

wants money," and would constitute a gigantic centralization of banking and finance.

As to aid to local public works, the President stated that "one of the most serious objections is that under the provisions of this bill those amongst 16,000 municipalities in the different states that have failed courageously to meet their responsibilities and to balance their budgets would dump their financial liabilities and problems upon the federal government." He opposed also the authorization of the R.F.C. to issue a large amount of additional securities unless these are to be backed by self-liquidating projects.

Louisiana May Borrow to Complete Highway Contracts

A resolution authorizing the state highway commission to borrow up to $2,500,000 to be used for the completion of existing road contracts was passed on July 5 by the Louisiana legislature. Existing uncompleted road contracts for which the commission is bound total $16,000,000, and the proposed loan plus federal aid and credit arrangements with railroads and material companies will allow the obligation to be met. The loan is not to be used for new contracts.

The work that the commission now has under contract include the river bridges at Morgan City, Krontz Springs, Shreveport, Moncla, Sterlington, Monroe, Harrisburg, and Jonesville.

State Bid for District Bonds Will Start Flood Control Work

Work on a $565,000 flood control project for the American River near Sacramento, Calif., can be started soon because of the state's bid for the first block of bonds. The issue was voted by the American River Flood Control District several months ago and on the recent call for bids the state's offer was the only one received; it was accepted by the directors of the district. The California state department of finance bid par at 6½ per cent interest for the block of $278,000 on condition that $62,500 from the sale would be turned back to the state as repayment for money advanced for preliminary work done by the state on the project. The work on the first units will be advertised for bids soon. Levee construction and channel improvement constitute the major part of the project.

San Francisco Has Another Plan for Garbage Disposal

Plans to grant a single franchise to collect and incinerate garbage were adopted by the San Francisco board of supervisors following the report and recommendation of A. J. Cleary, chief administrator and Dr. J. C. Geiger, public health director. The board ordered the necessary legislation prepared to make the plan effective. Meantime the old, overloaded incinerator will be used, pending action on the new plan, although Dr. Geiger declares it "a positive and definite health menace." The operation of the present garbage disposal plant in San Francisco and the agitation for change which has been before city officials for years have been noted in these columns at fairly regular intervals.

The plan outlined by the two officials, the most recent of many proposed during the past few years, consists of granting a 25-year franchise, based on competitive bidding with heavy bond for good performance, for the collection and incineration of the city garbage. The plant would revert to the city at the end of the franchise.

The franchise would incorporate provisions to protect all public health requirements. It would not involve use of municipal funds. A first requirement for the carrying out of the plan would be the repeal of the present city ordinance limiting cost of incineration to $1 per ton. It is hoped to get repeal measure on the November ballot. With this ordinance repealed it would be possible to carry forward the next steps in the suggested plan.

Seattle Makes Severe Reduction In City Salaries

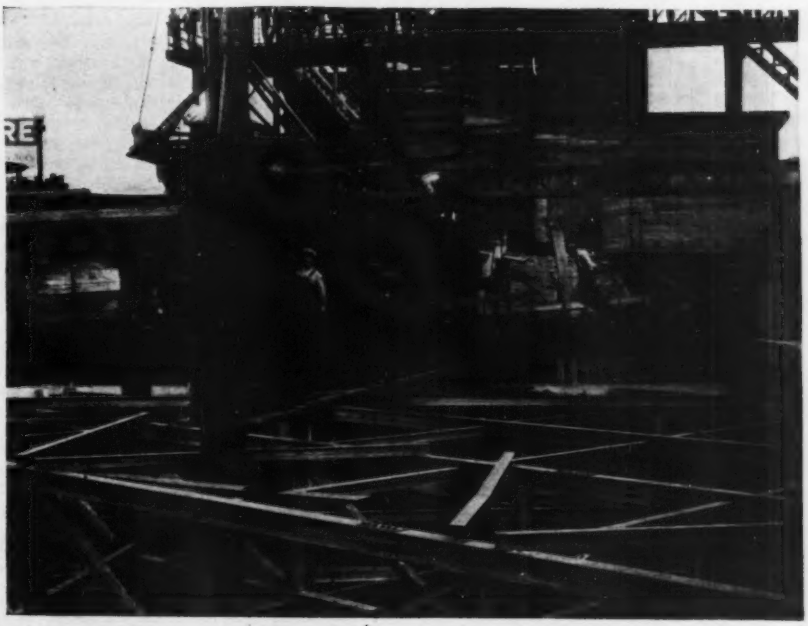
In an attempt to balance the budget and place the city payroll on a cash basis, a sweeping program of economy has been placed in effect in Seattle, Wash., designed to reduce the annual expenditure about $1,500,000. Among the other economy measures adopted the heads of all administrative departments have been reduced in salary to $250 a month.

Power Commission Denies Postponement of White River License

IN an order made public on July 7, the Federal Power Commission stated that it had no authority to grant a postponement to the Empire District Electric Power Co., in issuing a license for a power project on the White River at Table Rock in Taney County, Mo. The commission allowed the company until December 1, 1932, to accept the license, but stated that this "does not mean that the applicant must begin construction at once."

The decision was rendered following a hearing on May 24, in which the company asked a delay of one year in issuing the license because it was felt that the adverse economic conditions at present make unfeasible the construction of the dam and hydroelectric project. It is estimated that the work will cost about $16,000,000, and ultimately will involve the expenditure of $30,000,000. The application for license was made Dec. 31, 1925.

The company's application for delay was based on the ground that the present economic conditions do not warrant the immediate development of the project. The opinion of the commission indicates that it is disposed to take judicial notice of existing economic conditions where it has authority under the



HEAVY GIRDERS MARK START OF ERECTION ON PITTSBURGH POST OFFICE

Steel erection on the new Pittsburgh post office was begun the latter part of June. The first girders of the new WP type (*E.N.R.*, Oct. 29, 1931) comprise the heaviest members. Six girders arranged in three pairs (one pair is shown) are designed to carry railroad tracks and ten stories of the building. The individual pieces are 10½ ft. deep, over 50 ft. long, and weigh about 30 tons each. Each girder flange is made up of half a 36 in., 300-lb. H-beam, 2 angles 8x6x1 in., and plates. The webs are double ⅜-in. plates. The Fort Pitt Bridge Works fabricated the steel designed by the inventors of this style of girder, Weiskopf & Pickworth, New York.

law to grant reasonable release, but in this instance denies any authority in the commission to preserve the priorities of the applicant company beyond the period allowed by the federal water power act.

Under the terms of the license as proposed to be issued, the company would be required to begin construction within two years from the date of issuance, and complete the project within five years from the date of issuance. The effect of allowing the company until Dec. 1, 1932, to accept the license is that it must begin construction at least by Dec. 1, 1934, if it is to retain its priority in the project.

Egyptian Government Will Build Irrigation Works on Upper Nile

The Egyptian government has decided to proceed with the Gebel Aulia Dam, an irrigation project on the upper Nile River. Arrangements are being made for the consulting engineers, Coode, Wilson, Mitchell and Vaughn Lee of London, England, to prepare estimates and receive bids. The work is estimated to involve an expenditure of $11,000,000.

The Egyptian ministry of public works is also asking for bids on the hydro-electric power development at the Assuan Dam.

Steel Makers Ask Exclusion of All Foreign Steel

An appeal has been made to Congress by the National Association of Flat Rolled Steel Manufacturers with offices in Cleveland to close American ports to all importations of foreign steel. Demoralizing prices rather than increasing actual tonnage of foreign steel constitute the real danger, says the association's statement. These prices, which include duty charges, say the steel makers, are $10 to $25 per ton less than American producers can name. Present tariff protection while conceded to be adequate for normal times is claimed to be of little consequence at present. Dumping of steel from Belgium not only in this country but elsewhere is given as the principal reason for low foreign steel prices. Steel manufacturers in Belgium, it is said, have turned their plants into public utilities to provide gas, electricity and power for surrounding territories, permitting them to lower prices on steel. Dumping of steel by other foreign countries has been carried on to keep plants running, say the American steel makers, and with many countries closing their markets to other than domestic steel, dumped steel is coming into the United States in increasing quantity. The American producers maintain that foreign steel is of inferior quality.

Contract for Hoover Dam Penstock Pipes Awarded to Babcock & Wilcox

CONTRACT FOR the four 30-ft. steel penstock pipes for the Hoover Dam project was awarded July 9 to The Babcock & Wilcox Co., Barberton, Ohio, at a price of $10,908,000. Bids were opened June 15 but formal award of contract was delayed pending a hearing last week upon complaint of the A. O. Smith Corp., Milwaukee, one of the other bidders, who charged that execution of the work would infringe on certain of its patents. The low bidder was required to post a bond of $6,000,000.

Out of twelve possible alternates included in the bidding, the contract was let for Item 1 of Schedule 1, which calls for 30-ft. main pipes, to be fabricated near the canyon rim on the Nevada side, transported by the government to landing platforms at the mouth of construction adits leading to the tunnels and placed by the contractor. Steel is to be shipped to the site on government bills of lading.

In brief the contract includes four 30-ft. pipes, of 1⅜-in. to 2⅞-in. shell thickness, all longitudinal joints to be arc-welded, placed within tunnels and supported by concrete saddles or tunnel lining. Two of the pipes go within the two existing inner 50-ft. diversion tunnels, the other two will be placed within two 37-ft. tunnels, one on each side of the river located above and to the river side of the inner diversion tunnels. These 37-ft. tunnels are to be driven by the general contractor on the project, Six Companies, Inc. From each of the four 30-ft. pipes, a 13-ft. steel penstock will lead to each of the sixteen turbines, four of the smaller pipes taking off from each of the main penstocks. Each of the upper penstocks will be continued downstream to terminate in canyon wall outlet control works; those in the diversion tunnels will continue some distance below the powerhouse, terminating in a set of outlet control works within the tunnel.

Specifications require work to be started within 30 days and fully completed within 1,975 calendar days. The pipe tonnage involved is estimated at more than 50,000 tons. A description of the entire penstock layout will appear in next week's issue.

Welding Patents Argued in Hearing

Protest of the A. O. Smith Corp. (*ENR* June 30, 1932, p. 928), against award of the Hoover Dam outlet pipe contract to the Babcock & Wilcox Co. was argued in a hearing before Joseph M. Dixon, acting secretary of the interior, at Washington on July 5. The specifications governing the work require welding by automatic machines, protection of the fused metal from the atmosphere, peening each layer of the metal as deposited, and chipping out and rewelding the point of the weld at the root of the groove.

At the opening of the hearing the Smith representatives gave notice that in case the award went to Babcock & Wilcox they would sue for injunction, that such injunction would delay the construction of the project, and that damages collectible by the Smith corporation would reach at least $2,000,000. E. C. Alvord, counsel for the Smith corporation, said that seven patents were involved and mentioned specifically a patent covering the chipping-out process. He presented legal argument to show that as to some of the patents the government would be liable for compensation, according to statute, while as to others the process of injunction might have to be invoked.

Citing an opinion of the Attorney General to the effect that *prima facie* evidence of validity attaches to a patent which is alleged to be infringed, Mr. Alvord demanded that the contract be awarded to the Smith corporation on the ground of its having such prima facie evidence. He argued that the government should not encourage infringement of patents; that it is not mandatory to award a contract to the lowest bidder; and that the Smith corporation is the lowest bidder if the probable damages for infringement are added to the Babcock & Wilcox bid.

For the Babcock & Wilcox Co. it was stated that the company will not use Smith patents, that the chipping-out process is old, and that the Smith patents come late in a crowded art. J. H. Covington, counsel for the Babcock & Wilcox Co. asserted that in demanding the award of the contract the Smith corporation indulged in a conclusive presumption without proving infringement, while if they went into the courts for injunction or damages they would have to prove their case. He expressed the company's willingness to place its performance bond at any figure that the department might stipulate. The Hoover Dam pipe specifications, he said, had been written in accordance with the general state of the welding art.

Concerning the estimate of minimum damages of $2,000,000 advanced by the Smith corporation, George I. Haight, counsel for the corporation, stated that a reasonable royalty for each patent would be 5 per cent of the amount of the contract for each of the patents involved.

Isaac Harter, vice-president of the Babcock & Wilcox Co., and E. H. McDermott, representing the Smith corporation, submitted statements of the experience that qualifies their companies as bidders on the contract. The award to the Babcock & Wilcox Co. followed on July 9, as above noted, but with the required bond placed at $6,000,000. The department ruled that it was not in its province to decide a patent-right issue and as it was protected against loss from any such issue it was obliged to award the contract to the lowest bidder.

Columbus Prepares for Vote On New Sewage Plant Bonds

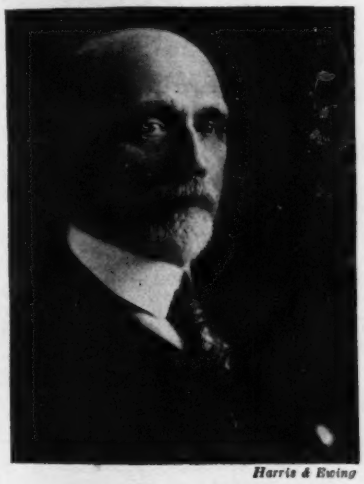
A move to bring about a popular vote on a proposed $3,500,000 bond issue for the construction of a sewage disposal plant for Columus, Ohio, will be made before the city council by the introduction of an ordinance providing for the issue and arranging for a referendum vote. Plans for the plant have been completed. Last year a referendum on the location of the site was held, and voters decided to retain the site of the existing plant. The construction was made necessary by an order of the state board of health in

1927, but the supreme court of the state has held that bonds for the project must be approved by the voters. State law limits such referenda to November elections. If the bond issue is turned down in November the city may assess a service charge for each sewer connection; such a plan, however, has been opposed by the mayor and other officials.

F. H. Newell Dies— Pioneer Reclamation Expert

Frederick Haynes Newell, the virtual creator of federal reclamation, first chief engineer and director of the U. S. Reclamation Service and later a teacher of engineering and consulting engineer, died at Washington on July 5 of a heart attack. His noteworthy career and remarkable personality are outlined in the following by his associate, Allen B. McDaniel.

Mr. Newell was born in Bradford, Pennsylvania, on March 5, 1862. His early education was obtained in the schools of Newton, Massachusetts, where he was



Harris & Ewing

graduated from the Newton High School in June, 1881. Four years later he received the degree of bachelor of science in mining engineering from the Massachusetts Institute of Technology.

After three years of field work in Colorado and other states, he was appointed on October 2, 1888, as assistant hydraulic engineer of the U. S. Geological Survey, being the first aid designated under Major John W. Powell to investigate the extent to which the arid regions of the United States might be reclaimed by irrigation. He advanced steadily in this work, expanding its scope and was successively made hydrographer and chief of the hydrographic branch. At this early period, Mr. Newell initiated and was in responsible charge of river flow, surveys and estimates of cost and capacity of reservoirs, investigations of ground waters and other allied work.

This preliminary work was directly succeeded by his work in the preparation and public presentation of various Congressional bills, one of which became the Reclamation Act of 1902. Immediately after that event, Mr. Newell was appointed chief engineer under Charles D. Walcott, then director of the U. S. Geological Survey.

During the next few years the organization of the Reclamation Service was developed and plans outlined for extensive work in each of the western arid states; work being started in most of them. In 1907, when Mr. Walcott was made secretary of the Smithsonian Institution, the Reclamation Service was organized as a separate bureau of the Department of the Interior with Mr. Newell as director and Arthur P. Davis as chief engineer. Construction was rapidly pushed until twenty-six projects were completed in whole or part, notably the Roosevelt, Shoshone, Arrowrock and Gunnison Tunnel. While director of the Reclamation Service, Mr. Newell made several special surveys and investigations, notably a first hand study of and report on the water resources of the Hawaiian Islands.

The breadth of his interests and activities are indicated in his work as one of the founders and first secretary of the National Geographic Society and also of the American Forestry Association. The early aim of both of these organizations was to arouse public interest in the proper conservation and utilization of our natural resources.

In July, 1914, as the result of the reorganization of the Reclamation Service he was made its consulting engineer. About this time he received the degree of doctor of engineering from the Case School of Applied Science.

During the spring of 1915, Mr. Newell was invited to become the head of the department of civil engineering of the University of Illinois. He succeeded the late Professor Ira O. Baker and reorganized and developed the civil engineering work over a period of five years. He also established an engineering library in the college of engineering during his stay at the University of Illinois.

Mr. Newell early realized the need of wider acquaintance and greater cooperation among engineers. A conference in Chicago, called through his efforts, led to subsequent conferences in which about 100 societies were represented. The final outcome was the American Association of Engineers, dedicated to welfare work and encouraging engineers to become broader men and better citizens. He became its president in 1919 and under his active leadership the number of members increased rapidly from 4,000 to 16,000.

In 1924, Mr. Newell cooperated with his friend, Allen B. McDaniel, in the organization of The Research Service; a group of consultants in various fields of engineering and construction for the purpose of making researches and rendering service to states, municipalities, private concerns and individuals. Up to the time of his sudden death, he was the president and at all times an active participator in the work of this agency.

Mr. Newell's last piece of work was the editing and compilation of the book "Planning and Building the City of Washington." This work was the result of the coordinated contributions of seventeen leaders of civic life in the nation's capital, and is the contribution of the Washington Society of Engineers to the Washington bi-centennial celebration.

His death occurred while he was engaged in some details of the work of the local committee on unemployment and public works of the Washington Society of Engineers and American Engineering Council.

Owyhee Dam to Be Dedicated

The Owyhee Dam, constructed by the Bureau of Reclamation in Oregon will be formally dedicated July 17 by the Secretary of the Interior. The dam is located near Nyssa, Oregon, on the Owyhee River, and is of the arched gravity type. It has the height of 520 feet and will remain the highest dam in the world until the Hoover Dam is completed. The reservoir capacity is 717,000 acre feet.

Hoover Dam Notes

During the fiscal year just ended 20,706,000 kw.-hr. of electricity were consumed in project activities at the Hoover Dam. Electricity was used throughout the fiscal year and, in fact, the fiscal year figures include four days of the preceding fiscal year, since operations began June 26, 1931. The cost of power used was $332,559, an average of 1.6c. per kw.-hr. During June 2,692,000 kw.-hr. of energy were used at a cost of $32,258.

* * *

Excavation of the open cuts for the Nevada and Arizona spillways was continued during the week ended July 2. Work was resumed on the Nevada spillway tunnel June 29. Blasting operations were carried on during the week at the site of the Nevada intake towers. Drilling is being done in connection with the excavation work at the site of the Arizona towers.

* * *

On July 26 the discharge of the Colorado River increased from 59,500 sec.-ft. to 72,700 sec.-ft. The river began to fall June 30. The maximum temperature in Black Canyon during the week was 112 deg. At Boulder City the maximum was 105 deg.

Denmark Places Contract for Europe's Longest Bridge

The Danish government has given Dorman, Long & Co., Ltd., Middlesbrough, England, the contract to build the Strostroemsbroen Bridge, connecting the islands of Zealand and Falster, and estimated to cost about $10,000,000. According to J. M. Osborne, manager of the firm's bridge department, it will be the longest bridge in Europe, its total length being over two miles. Some 29,000 tons of steel are involved and about 3½ years is the estimated construction period.

The bridge will carry side by side a roadway and a single railroad track that will link up the railroads of the two islands and replace the present steamer service between Masned and Orehoved. There will also be a cantilever footway at one side. It is proposed by the Danish state railways department that the bridge shall consist of a series of two-hinged arches. The approach spans are to be steel deck arches, encased in concrete, their spans ranging from 132 ft. near the coastlines to 266 ft. toward the center of the channel. The main spans will be three two-hinged steel arches, of 440 ft., 540 ft., and 440 ft. respectively. The vertical clearance above the water will be 87 ft. for a width of 400 ft. in the center span, and 85 ft. for a width of 300 ft. in the two main side spans.

The piers are to be of concrete con-

struction in open cofferdams. Maximum water depth is about 50 ft. and foundation material is clay. The contract includes the construction of a subsidiary bridge, 650 ft. long, of six spans, including an opening span of 100 ft. Thus the entire structure will be nearly 2¼ miles in length.

Personal Notes

TATNALL C. SIMPKINS, Major, Corps of Engineers, has been transferred from duty with the 6th Engineers, at Fort Lewis, Wash., to the 1st Engineers, Fort Du Pont, Del.

GEORGE M. SHEPARD, has been appointed chief engineer of the city of St. Paul, Minn. Mr. Shepard has been assistant chief engineer for the Metropolitan Drainage Commission, St. Paul.

L. B. WORSHAM, Major, Corps of Engineers, who has been stationed at Memphis for five years, has been ordered to West Point.

Obituary

CHARLES B. MYERS, president and founder of the Myers Construction Company, died at his home in Clayton, Mo., on June 30. Mr. Myers was 66 years old. He had been ill for about a month. The Myers Construction Company was organized 20 years ago after Mr. Myers had been in the service of the Missouri-Pacific Railroad.

M. P. DAVIS, well-known Canadian contractor, died at Ottawa, on June 26, age 83. Mr. Davis constructed the piers for the Quebec Bridge, sections of the National Trans-Continental Railway, Lachine Canal, and Gallops Canal.

ERNEST GEORGE HOPSON, who had been engaged in engineering work in Oregon for 26 years, died in a hospital in Portland, Ore., on July 4, at the age of 64. He was born in Reading, England. During his earlier years he had been engineer of the Manchester Ship Canal in Massachusetts and was later a member of the Metropolitan Water Board of the New York Water Supply. During his residence in the west, he had served for a time as supervising engineer of the United States Reclamation Service.

SOCIETY CALENDAR

NEW ENGLAND WATER WORKS ASSOCIATION, annual meeting, Springfield, Mass., September 27-30.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Washington, D. C., October 24-27.

SOUTH CAROLINA SOCIETY OF ENGINEERS held its annual meeting at Lake Murray, near Columbia, on July 4. Governor Blackwood of South Carolina was one of the speakers on the program.

PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION held its 5th annual conference at State College on June 20, 21 and 22. Consideration was given to a consolidation of the association with the Pennsylvania Sewage Works Association. The executive committee is to report on the matter at next year's conference.

THE INTERNATIONAL FEDERATION FOR HOUSING AND TOWN PLANNING will hold its next annual congress in Boston in late September or early October of 1932.

License Required of Contractors On Federal Work in Oregon

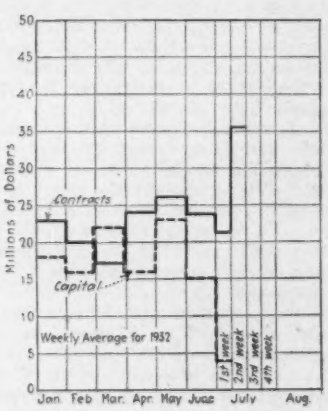
Contractors from outside the state of Oregon must obtain a license to do business in that state when engaged on Federal work, according to a ruling made for the state corporation commission by the attorney general. The attorney general's ruling was the result of a claim made by Hallbauer-LaBahn, Inc., contractors for the Federal Post Office Buildings at Astoria and Corvallis, that as its contract was for Federal buildings, it was in effect, an agency of the Federal government and so not subject to taxation. As ground for his decision, the attorney general cited the ruling of the U. S. Supreme Court in the Baltimore Shipbuilding and Dry Dock Company versus Baltimore, in which the report said that it is extravagant to say that an independent private corporation for gain, created by a state, is exempt from state taxation, either in its corporate person or its property, because it is employed by the United States, even if the work for which it is employed is important and takes much of its time. The attorney general stated that in view of the above the conclusion is obvious that Hallbauer-La Bahn, Inc., should qualify as a foreign corporation to do business within the state.

Engineering Contracts and Capital

Heavy engineering contracts reported for the past week total $35,736,000, the second high week for the year, exceeded only by the week of June 9, which totaled $43,555,000. This brings the average weekly total awards for July up to $28,896,000, as compared with a weekly average of $49,022,000 for July, 1931. Cumulative contracts from the first of the year to date total $656,322,000. Last year the cumulative total at this time was $1,527,334,000. Although the cumulative total for 1932 is 57 per cent under that for 1931, the percentage of loss has been steadily declining, indicating that construction so far has failed to follow the early summer slump trend encountered last year.

Of the past week's contracts, nearly $14,000,000 is represented by federal government work and another $14,000,000 by streets and roads. The largest contract let during the week was for the penstock pipes at Hoover dam, amounting to over $10,000,000. New York state let highway contracts totaling $3,300,000. Other large highway contracts reported were Illinois, $2,400,000; Ohio, $1,200,000 and Texas, $1,900,000. A strong increase was noted in contracts for highway bridges, a total of $1,339,000 being reported for this class of work. The first railroad construction contract reported for some time was let last week in West Virginia by the Virginian Ry. for a 5-mile extension from Justice to Gilbert, to cost between $300,000 and $400,000.

New York Construction Employment—An increase in the number of construction workers in New York State amounting to 22.7 per cent from May to June was reported by the state department of labor. Employment in highway work increased 55.4 per cent.



Contracts and Capital

CONSTRUCTION
(Thousands of Dollars)

	Weekly Average July 1931	Average July 1932	Week July 14 1932
Federal government	$4,512	$13,060	$13,979
State and municipal	25,245	11,979	18,295
Total public	$29,757	$25,039	$32,232
Total private	19,265	3,857	3,504
Week's total	$49,022	$28,896	$35,736

Cumulative, Jan. 1 to date:	
1931 construction	$1,527,334
1932 construction	656,322

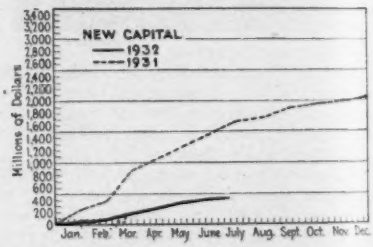
Decrease, 57 per cent.

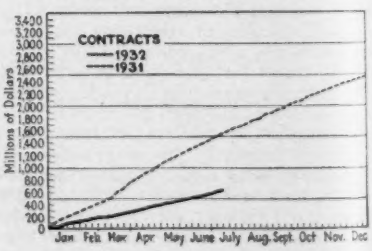
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Weekly Average July, 1931	Average July, 1932	Week July 9, 1932
Total private and public	$41,500	$4,000	$4,000

Cumulative, Jan. 1 to date	
1931 new capital	$1,506,500
1932 new capital	439,000

Decrease, 71 per cent.





ENR Cost and Volume Index

Cost		Volume	
July, 1932	153.36	June, 1932	131
June, 1932	152.20	May, 1932	149
July, 1931	174.37	June, 1931	243
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.85	1930 (Average)	260
1913 Average	100.00		